UNITED STATES DEPARTMENT OF AGRICULTURE
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# THE ANGORA GOAT AND MOHAIR INDUSTRY

Prepared by the

INTERDEPARTMENTAL ANGORA GOAT AND MOHAIR COMMITTEE

DEPARTMENT OF AGRICULTURE

BUREAU OF AGRICULTURAL ECONOMICS
G. T. Willingmyre, Chairman
James J. Window, Secretary

BUREAU OF ANIMAL INDUSTRY
D. A. Spencer - J. I. Hardy

FOREST SERVICE
W. R. Chapline

DEPARTMENT OF COMMERCE

BUREAU OF FOREIGN AND DOMESTIC COMMERCE
Frank E. Fitzpatrick

BUREAU OF STANDARDS
Charles W. Schoffstall

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## STATEMENT OF COOPERATION

THIS study was made jointly by the Bureau of Agricultural Economics, the Bureau of Animal Industry, and the Forest Service, of the Department of Agriculture, and the Bureau of Foreign and Domestic Commerce and the Bureau of Standards, of the Department of Commerce. Acknowledgment is made to the following specialists of these bureaus who cooperated with the Interdepartmental Angora Goat and Mohair Committee in this work: J. A. Burgess, W. C. Davis, Frank Grayson, C. Nagel, and H. S. Yohe, Bureau of Agricultural Economics; M. C. Hall, C. D. Marsh, G. W. Pope, R. P. Steddom, and H. J. Washburn, of the Bureau of Animal Industry; and W. A. Dayton, Forest Service, Department of Agriculture; B. J. Wilson, Bureau of Foreign and Domestic Commerce; and R. E. Lofton and J. Miller, Bureau of Standards, Department of Commerce; and to A. C. Gage, of Portland, Oreg., who represented the viewpoint of the industry and made valuable suggestions to the committee.

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By the *Interdepartmental Angora Goat and Mohair Committee:* GEORGE T. WILLINGMYRE, *Chairman;* JAMES J. WINDOW, *Bureau of Agricultural Economics;* D. A. SPENCER *and* J. I. HARDY, *Bureau of Animal Industry;* W. R. CHAPLINE, *Forest Service, Department of Agriculture;* FRANK E. FITZPATRICK, *Bureau of Foreign and Domestic Commerce; and* CHARLES W. SCHOFFSTALL, *Bureau of Standards, Department of Commerce*

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## IMPORTANCE OF THE ANGORA GOAT INDUSTRY IN THE UNITED STATES

Angora goats play an important part in the scheme of agriculture in certain areas. They not only furnish a cash return to the farmers, through the sale of mohair and meat, but they can be of considerable value in keeping down sprout growth in pastures or in clearing sprout growth in sections to be cleared for farming. The use of Angora goats for clearing brush from farm and pasture lands is especially prominent in the East, the middle West, the Ozark region, and the Pacific Coast States. On the ranges of the West, especially in the Southwest, goats are grazed for the purpose of utilizing the

browse type of vegetation on a permanent basis. On many range areas, where brush is the main forage, proper stocking with Angora goats has afforded a better financial return in recent years than it was possible to obtain on those areas by grazing other classes of livestock. On brush-range areas of Texas, Angora goats are used for diversification of the ranch business, and the grazing of them on the range makes possible a profit from many areas that would doubtless be unprofitable with cattle or sheep alone. As the value of Angora goats is appreciated, there will be considerable expansion of the industry on range areas supporting browse which can not be used as satisfactorily or economically by other classes of stock, but which, at the present time are stocked by those other classes.

Mohair, the chief product of the Angora goat, is important in the manufacture of upholstery materials and of men's summer suits and for lining materials. It is also used in the manufacture of braids, draperies, laces, hats, piled fabrics for coats, and for decorative trimmings.

As an upholstery material, mohair is usually in the form of a pile fabric and is unsurpassed for general durability. These fabrics are used for automobile upholstery and for railroad car seats, where the fabrics must withstand the hardest kind of service. Nor is it necessary to sacrifice esthetic properties to gain this degree of durability, for it is possible to make many beautiful coverings by variations in the pile height and structure, as well as by embossing and hand block printing. As a rule these pile fabrics have a cotton fabric base.

Mohair is used in men's summer suitings, in all-mohair fabrics and in numerous combinations with other fibers, sometimes mixed in the yarn structure, but usually as either the warp or the filling of the fabric. One of the much-advertised brands of men's suitings is made of mohair yarn in one direction and worsted yarn in the other. As a lining for suits mohair is used extensively, woven plain or twilled, and here also it is sometimes combined with wool, cotton, silk, or rayon.

Because of its resilient nature and because it takes dyes brilliantly and retains the colors well, mohair fiber serves admirably for nets, laces, and drapery materials, and many novel effects are obtained in decorative trimmings for coats, hats, and shoes. The long silky pile is bound into the base of the fabric and then curled, embossed, or otherwise processed to give the desired effect. It is possible, by ingenious construction and dyeing methods, to imitate many of the furs, and to produce materials which are not only attractive but serviceable.

The long-fibered mohair is particularly desired for use in the manufacture of wigs and switches which are used extensively for theatrical purposes. It is probable that the value of the mohair entering into the manufacture of these products represents a larger amount of money for the weight of mohair used, than does that used in any other branch of the industry.

Rugs of beautiful appearance, with long pile, are made from mohair. The design is frequently effected by hand block printing. These rugs compare favorably in appearance and durability with handmade oriental rugs.

Leather made from the pelt or skin of the Angora goat is useful for ornamental purposes and for the manufacture of gloves, purses, bookbinding, and novelties.

The value of chevon, the meat of the Angora goats and kids, is important to the producers and must be considered in summing up the value of the industry in the United States.

## COMPOSITION AND CHARACTERISTICS OF MOHAIR FIBERS

Most animals which grow wool, hair, or fur, originally had two coats, an outer or protective covering and an under coat which provided warmth. The development of these two coats varies with the climate in which the animals live, and it has also been greatly modified under conditions of domestication, where protection has been provided and special attention has been given to breeding. In the case of the fur-bearing animals the fine under coat is the true fur.

The wild goat has these two kinds of hair. The outer coat of coarse hairs constitutes the great bulk of covering on these animals. The hairs are very coarse and brittle and have large medullary canals divided by thin-walled partitions forming cells containing air or gas. The cuticular scales are observable only with difficulty. They surround the cortex, which constitutes only a small portion of the fiber. These coarse hairs have a close resemblance to the kempy and coarse medullated fibers of the unimproved Angora goats. (Fig. 1.)

The downy fibers which constitute the under coat are very fine and delicate and bear resemblance to the improved mohair of to-day. They have a well-defined cuticular scale development and a well-developed cortex, but they lack entirely the medullary development found in the large fibers.

Mohair, the long lustrous covering of the Angora goat, is an important textile fiber because of its luster, fineness, length, strength, and spinning and dyeing qualities. Its lack of felting properties also adds to its value as a textile fiber.

### CHEMICAL COMPOSITION

The chemical composition of mohair fibers is similar to that found in hair, wool, and feathers. It is very complex, like other proteins, containing many amino acids.

Although under certain conditions mohair is both acid and basic, it seems to have a much greater attraction for acid than for basic dyes. (*21, p. 189.*)[1]

These properties cause an affinity for acid dyestuffs, and acids in general. Due to this attraction for acid dyes, and to the structure of well-grown mohair fibers, fast brilliant colors may be produced upon them. Certain of these amino acids may be responsible for the desirable properties of toughness and elasticity.

Mohair, like wool, is very hygroscopic and can take up 25 to 30 per cent of moisture without seeming wet. The amount of moisture it contains depends on the kind and condition of fiber and the relative humidity of the air. This factor is important since mohair is bought on a weight basis.

[1] Italic numbers in parenthesis refer to "Literature cited," p. 118.

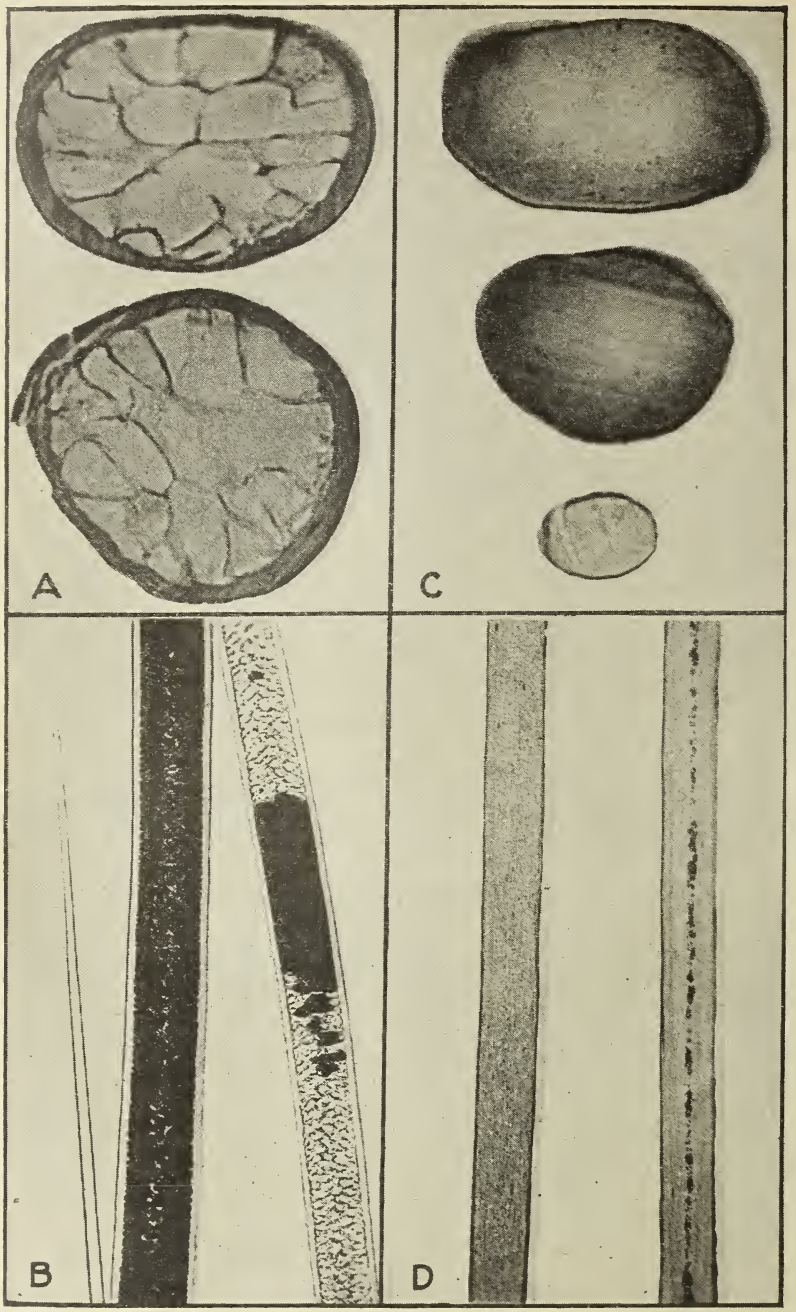


FIG. 1.—Mohair photomicrographs. A, Two cross sections of mohair kemp showing cellular structure; B, mohair kemp showing pigmented fiber and partially pigmented fiber, also a tip; C, three cross sections of mohair fibers of different diameters, showing solid structure; D, mohair (third combing grade) showing one fiber partially pigmented. (Cross sections, 300 magnifications; longitudinal views, 100 magnifications)

## STRUCTURE OF MOHAIR FIBERS

Mohair is more nearly allied to wool than to what is commonly known as hair. Mohair fibers are long and silky and have an excellent luster. The surface or epithelial scales are somewhat pointed and partially overlap, producing in general a smoother surface than wool.

A mohair fiber grows from a tubular sheath in the skin called a follicle, which projects upward. In the base of this follicle the mo-

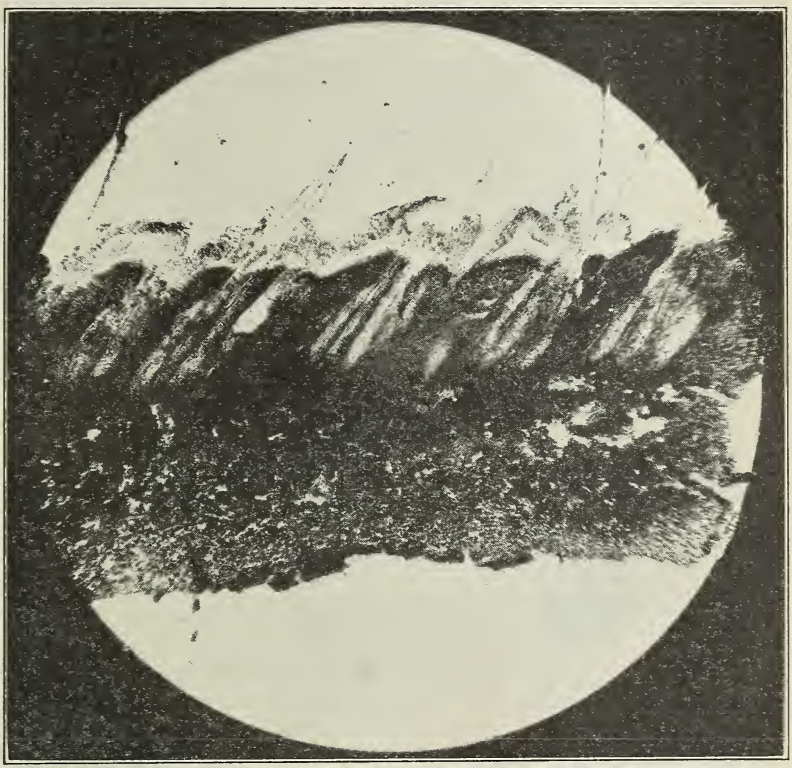

FIG. 2.—Cross section of a piece of Angora goatskin showing the outside of several mohair follicles

hair fiber is first formed. At the bottom end of the follicle is the hair papilla. Around the follicle and near the papilla, skinlike cells are formed, which as they multiply push themselves up through the papilla or mouth of the follicle to form a hair fiber. A mohair fiber is quite plastic when first formed, but as it gets nearer the surface of the skin it hardens.

How a mohair fiber starts to grow is better understood by making a close examination of the cross section of a piece of goatskin through the center of the follicle and its papilla, shown in Figures 2 and 3.

On the surface of the mohair fiber is the cuticle consisting of horny scalelike cells. These cells give the fiber its serrated appearance when examined under a microscope. (Fig. 4.) To the naked eye well-grown mohair has a smooth and shiny appearance. Under the miscroscope mohair fibers are much more uniform in their general appearance than wool fibers, and ordinarily show serrations to a less degree. However, there is considerable variation in the serrations according to the source and size of the individual fibers and

FIG. 3.—Cross section of Angora goatskin showing the inside of follicles and papillae

the portion of the fiber examined. Some have a well-defined scale structure even more pronounced than that found on some wool fibers, and others have very little scale structure. The surfaces of the individual scales of mohair fibers appear smoother and the scales are thinner than those found on wool fibers.

The physical properties of the mohair are best considered in comparison with other animal fibers. Bowman's (*3, p. 217*) results have been quoted by Matthews (*17, p. 102*) and in the International Critical Tables, Vol. 2 (*18*). They are summarized in Tables 1 and 2.

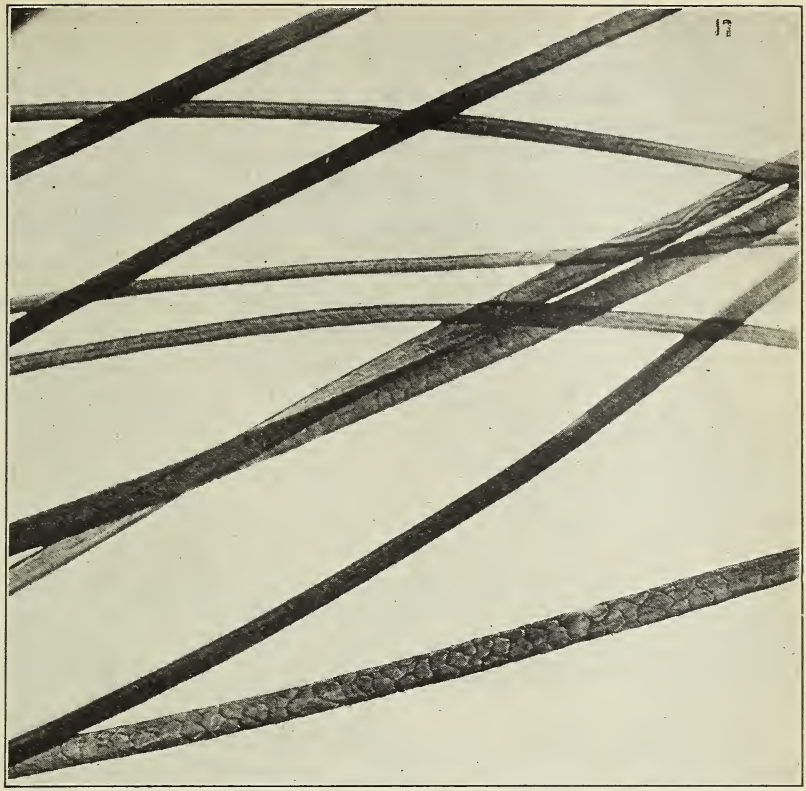

FIG. 4.—Photomicrographs of mohair fibers showing serrations

TABLE 1.—*Strength, elongation, and diameter of some animal fibers*

| Kind of fiber | Breaking strength | Elongation | Diameter |
|---|---|---|---|
| | *Grains* | *Per cent* | *Inch* |
| Human hair | 1,641 | 36.6 | 0.00332 |
| Wool: | | | |
| Lincoln | 502 | 28.4 | .00181 |
| Leicester | 473 | 27.3 | .00164 |
| Northumberland | 429 | 27.0 | .00149 |
| Southdown | 86 | 26.8 | .00099 |
| Australian Merino | 50 | 33.5 | .00052 |
| Saxony Merino | 39 | 27.2 | .00034 |
| Mohair | 586 | 29.9 | .00170 |
| Alpaca | 149 | 24.2 | .00053 |

TABLE 2.—*Relative breaking strength for equal cross sections of fiber*

| Kind of fiber | Relative breaking strength | Kind of fiber | Relative breaking strength |
|---|---|---|---|
| Human hair | 100.0 | Wool—Continued: | |
| Wool: | | Australian Merino | 122.8 |
| Lincoln | 96.4 | Saxony Merino | 224.6 |
| Leicester | 119.9 | Mohair | 136.2 |
| Northumberland | 130.9 | Alpaca | 358.5 |
| Southdown | 62.3 | Cotton, Egyptian | 201.8 |

The temperature (but not the humidity) was kept uniform at 60° to 65° F. All fibers were unscoured. Selected fibers were taken from the samples available. The figures under "elongation" (termed "elasticity" by Bowman) represent the per cent increases in length at time of break.

A comparison of strength for equal cross sections of fiber using human hair, which has the largest diameter, as 100, is given in Table 2.

Some tests made at the United States Bureau of Standards to determine the relative strength of the several grades of mohair are shown in Table 3.

TABLE 3.—*Some tests of the breaking strength of different grades of mohair*

| Grade | Breaking strength | |
|---|---|---|
| | Grams | Grains |
| First combing | 23.0 | 355 |
| Second combing | 35.0 | 540 |
| Third combing | 64.0 | 988 |
| Kid hair | 9.4 | 145 |
| Kemp | 30.0 | 463 |

These tests were made after conditioning the mohair at 65 per cent relative humidity at 70° F. on an inclination balance type of machine.

Matthews (*17, p. 209*) adapts some information from Barker on four kinds of fibers which are somewhat similar in construction and are sometimes competitive. This is given in Table 4.

TABLE 4.—*Mohair compared with three similar fibers*

[Matthews's adaptation from Barker]

| Property | Mohair | Alpaca | Camel hair | Cashmere |
|---|---|---|---|---|
| Length, inches | 9 | 12 | 5 | 3. |
| Strength | Very strong | Fairly strong | Fairly strong | Fairly strong. |
| Luster | Very high | High | Good | Good. |
| Color | White | Varicolored | Brownish | Brown and white. |
| Fineness, inch | 1/700 | 1/800 | 1/800 | 1/12000. |
| Handle | Fairly soft | Soft | Soft | Very soft. |
| Form of staple | Straight | Straight | Fairly curly | Fairly curly. |
| Uniformity | Uniform | Uniform | Fair | Fair. |

The strength and elasticity of mohair compare favorably with wool, as shown in Table 1. The practical absence of felting properties in mohair fibers makes them particularly adapted for certain kinds of fabrics, but mohair should not be used in fabrics which are to be fulled or felted, as the fiber and resulting fabric have a somewhat harsh, wiry nature.

The mohair fleece may be considered ideal if it is made up entirely of a long, dense growth of fine, bright, lustrous fibers, free from medullated fibers. Fine mohair is generally free from medulla, but as the mohair fibers become coarser, the presence of medulla is more frequent. This would lead to the belief that breeding of coarser mohair would bring with it a tendency toward an increased number of medullated fibers, with a consequent decrease in luster and uniformity of the fleece.

### KEMP

Kemp is the extreme type of medullated fiber and is easily recognized in the fleece because it is so much coarser than the surrounding mohair fibers. Examination of a large number of fibers under the microscope showed that the kemp fibers increased in diameter from the base toward the tip but that at the tip end they tapered down to a sharp point. This short tip end is not medullated.

Considerable study has been given to the subject of kemp, both in wool and mohair, but unfortunately the published accounts have been given little circulation in the United States.[2]

Kemp characteristics such as whiteness, and lack of strength, elasticity, and apparent dyeing affinity are due to the inclusion of air within the network of cells of honeycomblike appearance which make up the inner core or medulla of such fibers. Kemp has a medulla at least in part of the length of the fiber. It has been found in the coarser grades that the portion at the tip is not usually medullated.

Kemp is very objectionable to the manufacturers, and it is very difficult for them to eradicate it completely from the mohair fibers by combing. If it is not entirely removed, it will show up very prominently in the finished fabric as coarse, stiff, bristlelike fibers, often white, and rarely if ever taking the dye to the same degree as do good mohair fibers. However, the short tip end of the kemp, which is not medullated takes the dye very readily. The rate of dyeing of the heavily medullated portion is so much slower than the rate for the rest of the mohair that very little of the dye is taken up by it in the time required for the good mohair fibers to reach the desired shade.

## WORLD DISTRIBUTION OF ANGORA GOATS

The original purebred Angora goat was described as being a comparatively small animal having a fine, lustrous, silky fleece which attained a length of 8 to 10 inches and hung in ringlets. The fleece weighed only about 3 or 4 pounds and was rather dry, having only a small amount of oil. The Angora goat was well able to endure both heat and cold, except for a few days after shearing, but it was not very resistant to humidity. It was subject to pneumonia and was generally considered as being rather delicate as compared with common goats.

The use of mohair can be traced back to the time of Moses (1571–1451 B. C.) for the Bible (*8*) records that Moses commanded the children of Israel, after being delivered from slavery in Egypt, to bring white silk and goats' wool to weave altar cloths for the tabernacle. From the purpose for which it was required, and the fact of its association with white silk, it may be presumed that this goats' wool was white and of a quality sufficiently fine in texture to mix with silk.

The first European record of the Angora goat appears in 1554, when Busbek, the Dutch ambassador of the Emperor Charles V at Constantinople, procured a pair of Angoras and sent them to the Emperor. However, mohair yarn was known before this date in western Europe. In 1555, Father Belon, who had traveled through Asia

[2] For the reader who is particularly interested the following list of articles is given: (*1–3, 5–7, 10, 11, 19, 20*).

Minor, wrote a brief description of the Angora goat. Another description was written about 1650 by Tournefort, who was the chief botanist to the French King. He reported that the goats dazzled with their whiteness, and that their hair was as fine as silk.

The first authentic record of the export of unmanufactured mohair to Europe was in 1820, when a few bales were shipped from Constantinople. Prior to this time, the export of raw mohair had been prohibited by order of the Sultan. The demand for mohair for spinning increased on the continent, and in 1835 England also began to spin mohair yarns. The machinemade yarns and fabrics of Europe became so superior to the Turkish hand-spun and hand-woven goods that, by 1839, the export of mohair yarn from Turkey ceased altogether, and the number of looms for weaving mohair fabrics in Angora decreased from 1,200 to about 50.

Many attempts were made to establish Angora goats in Europe, but none of these attempts were successful. Probably the first attempt was made by the Spanish Government, which imported some Angoras in 1765. About 20 years later, the French imported a considerable number of Angora goats from Turkey, with the intention of establishing this industry in the Low Alps, in 1787. However, the French Revolution and the wars which followed prevented proper care and attention being given to the experiment, and the goats finally disappeared. It was not until 1837 that Angoras were first introduced into England by the Earl of Derby and Titus Salt. This attempt, however, was also doomed to failure.

The rapid growth of manufacturing in Europe created such a tremendous demand for mohair that the Turks were unable to increase their herds rapidly enough to meet it. This resulted first in the crossing of the Angora bucks on the common Kurd does, in an effort to increase quickly the number of mohair-bearing animals by grading up the common goats of that region. Then, too, the area over which the Angora goats were raised was greatly expanded. In fact, the demand for the mohair became so great that quality was no longer considered important, and the breeders selected their sires for weight of fleece, so that an animal with a coarse heavy fleece was more valuable than one with a fine silky fleece of less weight. Crossing with these Kurd goats became so general that the purebred Angoras were practically eliminated, and at the present time the new type of Angora goat is a larger and hardier animal and yields a heavier though somewhat coarser fleece than the original purebred Angora.

The first importation of Angora goats into South Africa was in 1838 and consisted of 12 bucks, 1 doe, and 1 buck kid born during the journey. Of these goats only the doe and the buck kid were of any value for breeding purposes, for the 12 imported bucks had evidently been rendered impotent by the Turks before they were shipped from Turkey. However, this buck was bred to the native goats of South Africa, and by a careful process of selection and inbreeding, herds of considerable excellence were established, and the progeny of this buck and doe spread throughout the colony. The descendents of these original Angoras were desired by the Boers, not so much for the mohair that they might produce but because the infusion of the Angora blood into the native herds made them less subject to disease, especially to scab, and the cross-bred progeny matured earlier, were

heavier, and their flesh was more palatable than that of the native goats.

No more goats were imported into the colony until 1856, and the descendents of the original importation had deteriorated considerably. In that year 30 pure-bred Angoras were imported by Mosenthal, and these were so well received that two more importations took place before 1860. By this time it was realized that the Turkish production would not be sufficient to meet the demands of the European manufacturers, and efforts were directed to the production of mohair in South Africa by grading up the herds of common goats with imported sires. (Figs. 5 and 6.)

The largest shipment to the Cape took place about 1869, when 720 Angoras were landed at Port Elizabeth by Blaine & Co., and 100 were landed by A. C. Stewart & Co. Importations continued until 1880, when the price of mohair began to decline, and the Turks, becoming alarmed at the increase in the herds of South Africa, prohibited the export of Angoras. However, about 3,000 Angoras had been imported to South Africa, and the industry had become firmly established there. See Table 5, showing the number of Angora goats in South Africa. In 1895 the Turkish Government was persuaded to allow two more shipments to the Cape, but none have been allowed since 1896.

In 1880 the industry faced a serious crisis brought about by the introduction of pleuropneumonia into the South African herds by goats imported from Turkey. A consignment of about 200 Angoras was shipped from Constantinople, and some of the goats were affected with this contagious lung sickness. As soon as the imported goats were placed with the South African herds, the disease broke out in a most virulent form. Attempts were made to check it by inoculating the goats, and about 44,000 animals were so treated, but it became apparent that the disease would never be eradicated by that method of treatment, and the Government decided to slaughter all of the infected goats. About 6,000 goats were killed, and the Government paid about $15,000 as compensation to the owners. The disease was thus finally stamped out after a loss of about 40,000 goats, and the Angora industry in South Africa was saved.

TABLE 5.—*Number of Angora goats in the Union of South Africa, Turkey, and the United States, in stated years*

[In thousands—i. e. 000 omitted]

| Year | Union of South Africa | Turkey | United States[1] | Year | Union of South Africa | Turkey | United States[1] |
|---|---|---|---|---|---|---|---|
| 1868 | 500 | | | 1915 | 2,885 | | |
| 1875 | 878 | | | 1916 | 2,564 | | |
| 1891 | 3,184 | 1,230 | | 1918 | 2,731 | | |
| 1892 | 3,184 | | | 1919 | 2,874 | | 1,933 |
| 1893 | 2,891 | 1,230 | | 1920 | 2,240 | | 2,346 |
| 1894 | 2,620 | | | 1921 | 2,285 | | 2,506 |
| 1898 | | | 248 | 1922 | 2,272 | | 2,231 |
| 1904 | 3,393 | | | 1923 | 2,285 | 1,610 | 2,280 |
| 1909 | | | 1,683 | 1924 | 2,217 | | 2,518 |
| 1911 | 4,275 | | | 1925 | 2,137 | 2,560 | 2,374 |
| 1912 | 4,395 | | | 1926 | | 2,740 | 2,899 |
| 1913 | 4,194 | | | 1927 | 1,499 | 3,162 | 3,159 |
| 1914 | | 2,086 | | | | | |

[1] Figures for 1920–1927 are for six States only, as follows: Arizona, California, Missouri, New Mexico, Oregon, and Texas.

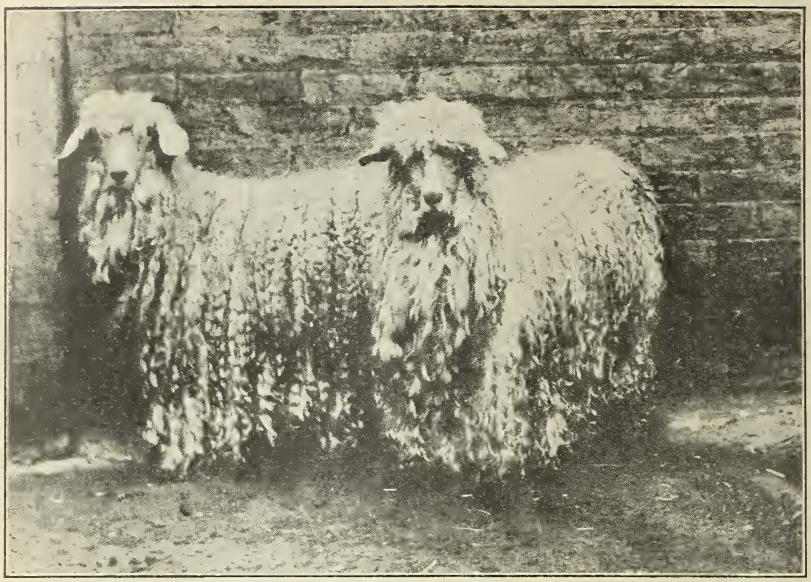

FIG. 5.—South African Angora does

FIG. 6.—Rhodes South African Angora buck

## DEVELOPMENT OF MOHAIR PRODUCTION IN THE UNITED STATES

### EARLY IMPORTATIONS OF ANGORA GOATS

It is now over three-quarters of a century since the first importation of Angora goats into the United States. A short time after the annexation of Texas to the Union and during the administration of President Polk the Sultan of Turkey requested him to recommend some one to experiment in the production of cotton in Turkey. James B. Davis, of Columbia, S. C., was recommended, and he received the appointment. When Doctor Davis returned to the United States in 1849 he brought with him nine choice goats, comprising seven does and two bucks. These goats were imported as Cashmeres and were so regarded until after all but three of them had passed into the hands of Richard Peters, of Atlanta, Ga., in 1853. However, Colonel Peters, who was a well-informed breeder of livestock, had his doubts as to the correctness of the name "Cashmere." He asked the Southern Central Agricultural Association of Georgia to appoint a committee to investigate this matter, and he made other efforts to get at the truth of the matter. He finally obtained sufficient evidence to satisfy him that this first importation of nine fleece goats belonged to the Angora breed.

This first importation was frequently exhibited at fairs and aroused much interest in Angora goats. At an exhibition of the United States Agricultural Society in Philadelphia during 1856 Colonel Peters exhibited these goats and was awarded $100 as a special reward. Publicity about these animals spread, and by 1860 it was reported in the Savannah Republican that Colonel Peters was selling his goats at very high prices; that he had received $1,500 for one buck and that a president of an Illinois fair was so pleased with one of the bucks on exhibition there that he offered Colonel Peters "the weight of the buck in silver for it." The three goats of the first (or Davis) importation which were not purchased by Colonel Peters were sold by Mr. Davis, one going to a Mr. Davenport, of Virginia, one to Wade Hampton, of South Carolina, and one to a Mr. Osborne, of New York.

About 1860 William Henry Stiles, of Cartersville, Ga., imported eight Angoras, which were reported to be larger and stouter than the Davis goats, but inferior in fleece. Winthrop W. Chenery, of Belmont, near Boston, Mass., imported 67 Angora goats from Turkey in 1861. In March of that year Mr. Chenery's first shipment, consisting of 29 goats, set sail from Constantinople, but when the shipment landed in Boston on May 15 it was found that 2 of the animals had died on the way. His second shipment of Angoras, consisting of 41 animals, started out from Constantinople early in October, 1861, and reached America late in November, only 1 goat having been lost. Further shipments of goats were made to Mr. Chenery, one of 20 head in 1866, and another of 20 head in 1867, but of these 40 goats only 30 arrived alive.

Israel S. Diehl was commissioned by the United States Commissioner of Agriculture in 1867 to visit the Province of Angora for the purpose of investigating the mohair industry. While there he purchased 160 Angora goats for shipment to the United States. Late in 1867 these goats arrived and were placed on the farm of C. S. Brown, Newark, N. J. C. P. Bailey, of San Jose, Calif., furnished the money

for the transportation of some of these goats to California, with the understanding that the first choice of them would go to him. He reported that some of these goats were fairly good and some were only ordinary. He considered them of medium size, and, with the exception of the neck he thought they were tolerably well covered with fleece. However, he said that their fleeces had a scattering of kemp throughout.

### EARLY DISTRIBUTION OF ANGORA GOATS IN THE UNITED STATES

Before the outbreak of the Civil War there were many fair-sized herds of Angoras in the South and Southwest. Smaller herds were also maintained in the North and West. In 1863, Mr. Diehl (*4*) of the United States Government reported herds containing from 12 to 300 goats near Atlanta, Ga.; Gallatin and Nashville, Tenn.; Russellville, Frankfort, Paris, and Georgetown, Ky.; Greenville, Lebanon, Montgomery, and Bucyrus, Ohio; Green County, Ind.; Chicago,

FIG. 7.—Herd of Angora goats on a farm in the Ozarks

Decatur, and Evanston, Ill.; St. Louis, Maramee, and Fayette, Mo.; Baltimore, Md.; Leavenworth, Kans.; Brownville, Pittsburgh, Washington, and Philadelphia, Pa.; New York City, N. Y.; Boston and Belmont, Mass.; Austin, Tex.; and in the States of Iowa, Michigan, Minnesota, California, and in other localities. This wide distribution made it possible to test in a fairly satisfactory manner the adaptability of Angoras to the various regions and climates of our country. However, during the Civil War little or no progress was made in the South, where the largest herds were then located and where there was most interest in Angora goats until about 1866. Soon after the close of that war the growing of Angora goats spread out into the West, principally into Texas and California. In those regions the natural conditions proved to be best suited to Angoras and the greatest development of the Angora goat industry has taken place in that part of the country; particularly in Texas and to a considerable extent in New Mexico, Arizona, California, Oregon, and Missouri (fig. 7).

In 1860 Colonel Peters sold two bucks that were about 16 months old to William M. Landrum, who was then located in San Joaquin County, Calif. They were shipped by express from Atlanta to St. Louis, on to Fort Leavenworth by steamer, and thence on foot to California with a wagon train. During that journey they lived on browse and arrived at their destination in good conditon. That same year Mr. Landrum exhibited them at the State Fair and was awarded a silver goblet and $25 in cash. One of these bucks after siring about 30 kids was killed by a snake bite, and the other, famous on the Pacific coast under the name of Billy Atlanta, lived to be 10 years old and was then killed in an accident. This old buck had sired about 2,000 kids, and he had won the sweepstakes prizes over all competitors at every State fair where he was shown until his death. It was claimed by Colonel Peters in 1876 that the numerous descendants of this buck were scattered all along the Pacific coast, and that his blood was coursing in the veins of goats in over half the Angora herds in that part of the Union. At that time it was estimated that approximately 70,000 Angoras were in that part of the country. Colonel Peters also claimed that about one-third of the purebred Angoras introduced into California by 1876 were contributed from the first and original (Davis) importation of 1849 and that he believed that their blood was then present in probably two-thirds or three-fourths of the Angora stock on the Pacific coast.

Mr. Landrum was in California from 1850 to 1883, after which he moved to Texas and with his sons continued his important operations in the breeding of Angora goats. Mr. Chenery's importation furnished 10 head for breeders in California. Of these 10, a pair went to C. P. Bailey, San Jose, at $500 each; a pair to Thomas Butterfield & Son, Watsonville; a pair to William M. Landrum, San Joaquin County; a pair to Mr. Pierson, Santa Cruz; and a pair to Flint & Sargent, Monterey County. This lot of goats was used in the early beginning of the breeding of purebred Angoras in California. The two Angora bucks sent by Peters to Landrum in 1860 were the only Angoras that preceded these 10 goats.

The 160 Angoras imported by Diehl in 1867 were taken to Ohio and later to California, where they were widely distributed in various parts of that State. Some of these goats sold for as much as $200 a head. In 1872 Mr. Landrum purchased all the goats under 8 years of age which were then owned by Colonel Peters, of Atlanta, Ga., and took them to California. In 1875 the entire herd of 150 goats owned by Butterfield & Son was purchased by William Hall, of California, for a total of about $17,000.

### LATER IMPORTATIONS OF ANGORA GOATS

In April, 1875, John S. Harris, who was a partner of William Hall, left Hollister, Calif., for a trip to Tibet for the purpose of purchasing Cashmere goats. After he reached India he decided that these goats could not be profitably acclimatized in California, and he therefore proceeded to Angora in Asia Minor. He had many difficulties, but finally succeeded in purchasing 10 does and 2 bucks. In March, 1876, they arrived in Baltimore at a cost of $525 a head landed in that port. These goats went on to California, and it is said that the blood of this importation was felt beneficially in every

good herd in that State. Records show that Mr. Harris later settled in Salem, Oreg. Figure 8 shows the present-day type of goats in the Northwest.

On January 31, 1880, a Boston daily newspaper reported the arrival of three Angora goats which were imported by C. W. Jenks of Boston. These goats were sold to Colonel Peters. The newspaper stated that these goats were brought some hundreds of miles on muleback to the coast from the Province of Geredeh, in the interior of Asia Minor. This paper also stated that Angoras previously received in the United States had been from Provinces near the coast and were smaller, with fleeces of 4, 5, and 6 pounds, while the Geredeh breed was larger, with fleeces of 8, 10, and 12 pounds and in some cases 15 pounds weight of mohair, very fine and silky. This story of such heavy fleece weights of fine silky mohair is very difficult to believe, for there seems to be no evidence that this importation was very satisfactory.

FIG. 8.—A herd of Angora goats in the Northwest

On August 13, 1886, an importation of two bucks and two does arrived at New York from Delagoa Bay, consigned to E. A. Shults for Fink & Co., of Leon Springs, Tex. It seems probable that this importation did not prove to be much of a success, as little was ever heard about it.

In 1893, C. P. Bailey imported two bucks from South Africa. One of these was named Pasha, and his get has been sent to nearly every State in the Union. In 1899, Mr. Bailey imported another buck from Capetown, South Africa.

Until the year 1901 the only American importers of Angora goats who had gone into the Province of Angora to obtain their animals were Israel S. Diehl and John S. Harris. In the early part of 1901, W. C. Bailey, of the firm C. P. Bailey & Sons Co., of California, visited Asia Minor for the purpose of purchasing Angora goats. The Vilayet or Province of Angora was the territory from which he set out to secure his Angora goats because it was understood

that the best animals of this breed could be found there. Many excellent goats were found in the sheltered valleys, and he purchased four of them. Although the Ottoman Empire since 1881 had strictly forbidden the exportation of any Angora goats, he proceeded to Constantinople and obtained permission to ship out these four goats, which were forwarded by way of Sicily. After experiencing many difficulties, he landed them in New York and then took them to California. After their arrival in California they were kept by themselves for a time to be sure that they carried no contagion, and they promptly began to improve in flesh.

These Turkish bucks were bred to does of good quality, and in the spring of 1902 the first crop of kids from them arrived. The new blood showed itself in the fineness of fiber and closely coiled ringlets. The fleeces of the kids were also very free from kemp. In the fall of 1903 two lots of bucks from these Turkish goats were distributed to many parts of the United States. It has been thoroughly demonstrated that the best Turkish goats have a very fine lustrous fiber, soft and pliable, almost free from kemp, but generally the fleeces are

FIG. 9.—Angora goats in Texas, showing fleeces of seven months' growth

not quite so heavy as those of the South African goats. The progeny of these four Turkish goats that were imported by Bailey in 1901 have taken many prizes at livestock shows.

Another importation was made in 1901 by William M. Landrum, who was then operating in Texas. This importation consisted of two yearling bucks from South Africa. They were bred by R. C. Holmes, and their sire was Dick, the prize buck at the Port Elizabeth show in 1900. The Bureau of Animal Industry received samples of mohair from the fleeces of these two goats. These samples were very fine and lustrous, but the most striking features about the fleeces of these two bucks were their excellence of length and weight and their freedom from kemp. Figure 9 shows a good type of goat in Texas.

An importation made in 1904 by G. A. Hoerle, of Midland Park, N. J., was one of the largest and most notable of all importations of Angoras into the United States. The Parliament of Cape Colony, South Africa, in 1899 had enacted an export duty of 100 pounds sterling on each Angora goat. It naturally was equivalent to a prohibition. Mr. Hoerle, who had visited South Africa and returned to the United States in the spring of 1902, had information that this

export tariff, which had been suspended at the time of the Boer War, would be reenacted during the next session of Parliament. He was enthusiastic to import a herd of Angoras, and in urging the Secretary of Agriculture of the United States to issue a permit he gave various reasons, including the following:

That the fleeces of the best Cape Colony goats are practically kempless.

That while the average mohair clip in the United States is not more than 2 pounds, in Cape Colony it is nearly 5 pounds, and of the very best herds, nearly 10 pounds.

That the evenness of covering and the density of the fleeces of the Cape Colony goats is very much superior to that of any animals in this country.

In one of his letters requesting the department to issue a permit for the importation of 40 or 50 bucks and 120 does with their kids, Mr. Hoerle stated that he intended to make his selections from the herds of seven of the most prominent breeders. He seemed especially concerned lest the South African Government might place a prohibition upon the exportation of goats before his proposed shipment could be effected. In mentioning the number of animals which he wished to obtain his statement was in part as follows:

This would give this country enough of high class Angoras to permit the husbandry to advance quicker in 6 or 7 years than we could otherwise do in 25 years and the necessity to inbreed in order to obtain good mohair would be avoided. I believe that considering the almost certainty of a reenactment it would be a permanent loss to this promising husbandry if the permission for this importation would be refused.

It would seem that Mr. Hoerle was well advised in his contention that an embargo would be placed by the South African authorities upon the exportation of Angoras, for soon after this time their export shipment to other countries was prohibited, and the embargo remained in effect for approximately 20 years.

The Secretary of Agriculture fully appreciated the dangers incident to the importations of livestock from foreign countries and hesitated to take the responsibility for any action which might endanger the great livestock industry of the United States. It was finally agreed, however, that if Mr. Hoerle would provide a suitable place for the quarantine of his goats on an island in New York Harbor a permit for their importation would be given subject to certain especial precautionary measures. Mr. Hoerle complied with all requirements, and in May, 1904, arrived at the port of New York on a British vessel with 148 South African goats. At the end of the quarantine period the goats were forwarded to Chester, Vt.

TABLE 6.—*Estimated number of goats clipped in the six leading producing States, 1920–1927*

[In thousands—i. e., 000 omitted]

| Year | Texas [1] | Arizona | New Mexico | Oregon | California | Missouri | Total |
|---|---|---|---|---|---|---|---|
| 1920 | 1,834 | 145 | 124 | 113 | 72 | 58 | 2,346 |
| 1921 | 1,984 | 145 | 128 | 115 | 74 | 60 | 2,506 |
| 1922 | 1,750 | 152 | 110 | 105 | 59 | 55 | 2,231 |
| 1923 | 1,797 | 160 | 110 | 103 | 57 | 53 | 2,280 |
| 1924 | 2,008 | 165 | 127 | 101 | 57 | 60 | 2,518 |
| 1925 | 1,857 | 162 | 120 | 110 | 58 | 67 | 2,374 |
| 1926 | 2,367 | 165 | 135 | 115 | 56 | 61 | 2,899 |
| 1927 | 2,579 | 185 | 165 | 115 | 52 | 63 | 3,159 |

Division of Crop and Livestock Estimates, Bureau of Agricultural Economics.

[1] Most goats are clipped twice a year in Texas, and kids are clipped in the fall of the year of their birth. Figures include both kids and goats clipped.

TABLE 7.—*Estimated average weight of mohair fleeces per goat clipped in the six leading producing States, 1920–1927* [1]

| Year | Oregon | Texas | California | Arizona | New Mexico | Missouri | Average |
|---|---|---|---|---|---|---|---|
| | *Pounds* | *Pounds* | *Pounds* | *Pounds* | *Pounds* | *Pounds* | *Pounds* |
| 1920 | 4.0 | 3.7 | 3.2 | 3.2 | 3.2 | 2.5 | 3.6 |
| 1921 | 4.0 | 3.8 | 3.3 | 3.3 | 3.3 | 2.5 | 3.7 |
| 1922 | 4.1 | 3.9 | 3.5 | 3.4 | 3.2 | 2.6 | 3.8 |
| 1923 | 4.1 | 4.1 | 3.7 | 3.5 | 3.4 | 2.8 | 4.0 |
| 1924 | 4.1 | 4.0 | 3.8 | 3.7 | 3.6 | 2.7 | 3.9 |
| 1925 | 4.2 | 4.6 | 3.8 | 3.7 | 3.7 | 2.8 | 4.4 |
| 1926 | 4.2 | 4.2 | 3.7 | 3.5 | 3.5 | 2.8 | 4.1 |
| 1927 | 4.2 | 4.4 | 3.9 | 3.7 | 3.7 | 2.8 | 4.3 |

Division of Crop and Livestock Estimates, Bureau of Agricultural Economics.

[1] Figures include both spring and fall clips where goats are clipped twice a year.

TABLE 8.—*Production of mohair (including kid hair) in the six leading producing States, 1920–1927*

[In thousand pounds—i. e., 000 omitted]

| Year | Texas | Arizona | Oregon | New Mexico | California | Missouri | Total |
|---|---|---|---|---|---|---|---|
| 1920 | 6,786 | 464 | 452 | 397 | 230 | 145 | 8,474 |
| 1921 | 7,607 | 479 | 460 | 422 | 244 | 150 | 9,362 |
| 1922 | 6,838 | 517 | 431 | 352 | 207 | 143 | 8,488 |
| 1923 | 7,352 | 560 | 422 | 374 | 211 | 148 | 9,067 |
| 1924 | 7,996 | 611 | 414 | 457 | 217 | 162 | 9,857 |
| 1925 | 8,519 | 599 | 462 | 444 | 220 | 188 | 10,432 |
| 1926 | 9,887 | 578 | 483 | 473 | 207 | 171 | 11,799 |
| 1927 | 11,312 | 685 | 483 | 611 | 203 | 176 | 13,470 |

Division of Crop and Livestock Estimates, Bureau of Agricultural Economics.

## FINAL DISTRIBUTION AND SETTLEMENT OF THE INDUSTRY

After the Civil War and the westward movement of the Angora goat industry herein mentioned under early distribution the growing of Angoras spread into many parts of the country. Introductions into new regions were often largely for the purpose of exterminating brush in the process of clearing new lands. In some of the regions where the Angora goats proved to be well adapted this interest in brush extermination developed into the desire for the best of Angoras for the growing of mohair. Finally the Angora goat and mohair growing industry has become firmly established in certain regions of the United States where these goats have proved to be especially well suited to the prevailing conditions of climate and to the customary methods of livestock management.

In 1920 the United States census (*22, v. 6, pts. 1, 2, 3*) reported that there were on farms in this country (including ranches) 2,101,591 goats that were raised for fleeces. Every one of the 48 States reported fleece goats, but 93.49 per cent of them were reported in Texas, New Mexico, Arizona, California, Oregon, and Missouri. Texas had 69.94 per cent of all the fleece goats in the United States, New Mexico had 6.29 per cent, Arizona 4.47 per cent, California 3.77 per cent, Oregon 5.97 per cent, and Missouri 3.05 per cent. Utah, Oklahoma, Arkansas, and Tennessee had a combined total of 83,252 Angoras, or 3.96 per cent of all that were in this country. Washington, Colorado, Kansas, Minnesota, Iowa, Wisconsin, Illinois, Indiana, Kentucky,

West Virginia, Virginia, New Hampshire, Louisiana, Mississippi, Alabama, and Florida had from 1,000 to 7,000 Angora goats each and a combined total of 46,111 which amounted to 2.19 per cent of the Angoras in this country. Thus the other 22 States not mentioned had only about one-third of 1 per cent of the American Angoras. The greatest concentration of Angoras in this country is on the Edwards Plateau of west Texas. For latest estimates on number of goats and production of mohair in the United States see Tables 6 to 8, pages 18 and 19.

In 1922 it was announced that the Union Government of South Africa had repealed the prohibition on the exportation of Angora goats. A movement was immediately begun by the Angora Goat Breeders Society of South Africa to develop a trade with breeders in the United States. In 1921, however, lung sickness or contagious pleuropneumonia was introduced into the Union from Bechuanaland Protectorate, and it was accordingly considered that conditions would not warrant the issuance of permits by the Secretary of Agriculture for the importation of goats from the Union. Somewhat later there was an improvement in the situation, and it was found possible to issue a permit to A. A. Perssee, Secretary of the Angora Goat Breeders Society of South Africa for an importation of Angoras into the United States. On May 7, 1925, this shipment, accompanied by E. Cawood of South Africa, consisting of 117 head, arrived at the port of New York, and following their quarantine as required under the import regulations the animals were forwarded to Texas for public sale. Thus, just 21 years following the notable importation made by Mr. Hoerle, breeders in the United States were enabled to obtain new blood from South Africa to improve their herds.

## IMPROVEMENT OF ANGORA GOATS

Angora goats in the United States have been developed through a long period of selective breeding. This has been accomplished by the use of imported stock and by crossing the improved Angora bucks on a foundation of common does. Improved breeding has progressed until now the use of common does is seldom practiced by Angora breeders or mohair growers. The supply of high-class Angoras is now so ample that it is more profitable to use them for founding herds for the production of mohair.

## REGISTRATION OF ANGORA GOATS

In 1900 a registry system was established for Angora goats by the American Angora Goat Breeders' Association. This system was initiated by means of official inspection of purebred and high-grade American Angoras and by admitting to the official register only such animals as measured up to the standard of excellence required by the association. From 1900 to 1924 all goats registered by the American Angora Goat Breeders' Association traced wholly within the lines of inheritance of this original-inspected foundation stock or to the goats that were imported during that period. The National Angora Record Association was organized and incorporated under the laws of Texas in 1918, and its register was established on the basis of inspected animals in a manner similar to the method followed by the

American Angora Goat Breeders' Association in 1900. The National Angora Record Association merged with the American Angora Goat Breeders' Association in 1924, accepting the arrangement of a restricted admission of the offspring from goats that had been recorded in the National association. The purpose of this restricted admission was to insure the acceptance of only meritorious stock. As a rule range herds of goats are composed of select high-grade does that are mated with purebred bucks purchased from breeders who specialize in the production of superior registered animals.

### CHARACTERISTICS OF IMPROVED ANGORAS

Mature Angora bucks when well nourished and of desirable type, weigh from 125 to 175 pounds, and bucks at 18 months of age, 80 to 100 pounds. The weights of finished wethers vary from 125 to 175 pounds; grown does weigh 80 to 125 pounds; and does 18 months old weigh about 60 to 80 pounds. On typical ranges the upper limits of weight are seldom reached. Mature bucks usually weigh about 130 to 135 pounds; 18-month-old bucks, 75 to 80 pounds; mature wethers, 90 to 140 pounds; mature does about 75 pounds; and 18-month-old does around 65 pounds.

The annual production of unscoured mohair per goat is about 3½ to 4½ pounds for the doe and kid band under range conditions, and for wethers about 4 to 5 pounds. Much of the mohair is taken off in two clips per year. This is particularly true of mohair grown in the Southwest. The fleece weights of Angora goats that are especially well bred and efficiently managed are of course heavier than the averages here mentioned, and purebred herds often clip double the above-mentioned quantities. The opinions of breeders vary as to the influence of the size of goats on their vigor and quality of hair. Extremely large goats often have comparatively coarse hair; however, this is not always the case. Fairly good size is generally associated with greater vigor than extremely small size. The largest goats that have fine fleeces are preferred by a large proportion of mohair growers because of physical capacity to produce a heavy fleece and a larger surface on which to grow it.

Both bucks and does have horns, and it appears that breeders have made no special effort to develop hornless strains of Angoras. The ears should be drooping; erect ears commonly known as "fox ears" are objectionable. The color for all Angoras is white. "Red kids" may be born occasionally, but even though they shed out and produce good mohair, it is regarded as the best practice to avoid the use of such goats for breeding stock as even practical mohair growers, who have only grade does, object to bucks from strains that produce off-colored kids.

The face covering of the animals should be rather full, and a complete covering over the belly is very much preferred. However, it should be understood that these points on exact covering are of less importance than such major considerations as vigorous constitution and well-developed fleeces excellent in quality, weight, and density.

A fairly liberal amount of natural oil is desirable for growing mohair. It gives life to the hair, helps preserve it, and assists in the protection of the skin from alkali and other irritating dust. A

skin that is soft and healthy is essential to the production of first-class mohair, and for this reason not only breeders of purebred goats, but all growers of mohair should endeavor to breed for a reasonable amount of natural oil in the fleeces. Several breeders have been successful in developing this natural-oil characteristic to an extent that was formerly considered impossible with Angora goats. In a good fleece of mohair the locks should have a fullness and natural development to the end of the lock without a narrowness or scantiness that is commonly called "gimlet pointed."

### TYPES OF FLEECES

The principal product of Angora goats is mohair. There are three primary types of fleece based on the formation of the lock, viz, the tight lock, the flat lock, and the fluffy fleece. Angora breeders generally prefer a well-developed tight lock or ringlet although the flat lock is preferred by some, and it produces a very desirable type of mohair. The tight lock is ringleted throughout almost its entire length, and it is the type that is most strongly associated with extreme fineness of mohair. (Fig. 10.) The flat lock is usually wavy and forms a bulky fleece; this lock is usually associated with heavy shearing weight and a satisfactory quality of hair. (Fig. 11.) The fluffy or open fleece probably stands lowest in character, and is objectionable on the range because it is easily broken and torn out to a greater extent by the brush.

### ELIMINATION OF KEMP FIBERS

One of the most important problems in the improvement of Angora goats and their mohair is the elimination of the kemp fibers, which greatly reduce the value of the fleece. The identification of kemp fibers may be based on the fact that they are relatively short, coarse, stiff, brittle, inelastic, and are of an ivory-white color. The hope for the elimination of kemp from the fleeces of Angora goats is seen in the possibility of selective breeding with kemp-free goats and the culling as rapidly and thoroughly as practicable of those goats that are producing kempy fleeces.

## MANAGEMENT OF ANGORA GOATS

A large portion of the Angora goats in the United States are maintained under range conditions. Angora goats are especially adapted to the use of many kinds of range forage, and since they can be handled in large herds they lend themselves to very economical use of certain range lands. They are also maintained with economy on many farms where the vegetation is particularly suited to their requirements and is of the kinds that can be most efficiently utilized by goats. Some of the most excellent purebred Angoras are kept in small or moderate-sized herds, whether on the range or on the farm. Specialized production of mohair on a commercial basis is, in a large measure, conducted on lands that are not adapted to the plow; thus for the industry as a whole, many of the growers' problems of practical management are those which apply to range conditions.

FIG. 10.—Angora goats with tight-lock type of fleece

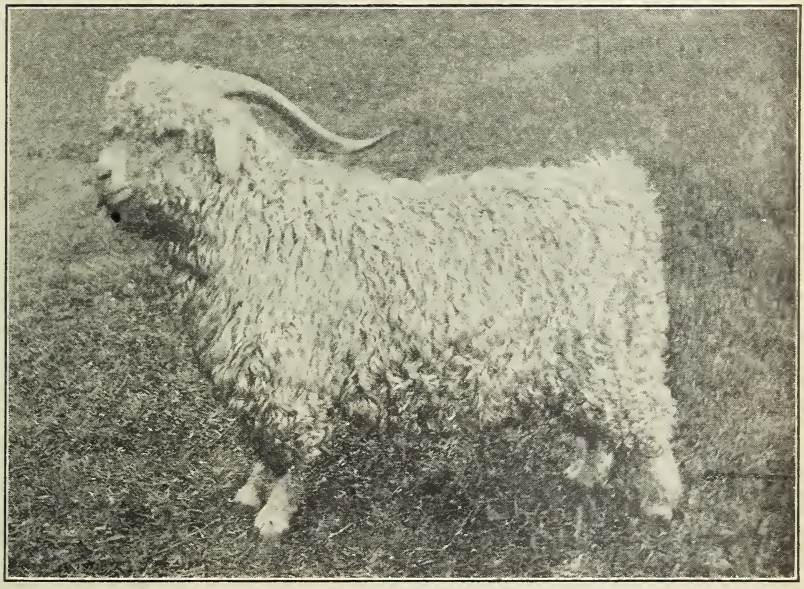

FIG. 11.—Angora buck with a flat lock type of fleece

## THE GOAT RANGE

The ideal goat range should possess forage suitable for goats at all times of the year, be well drained and free from continued heavy rains, and be adequately supplied with watering places and suitable bed grounds. Since browse furnishes the bulk of range feed for goats throughout the year, there should be an abundance of this available. Grass and weeds are necessary for does and kids during the spring and summer, but not during the winter. They are not essential for wethers at any time. They are of considerable value at all times, however, to give variety to the forage. On extensive areas, the stand of brush should be sufficiently open to allow herding of the goats. On small areas the brush may be dense. Extensive areas where brush grows too dense for immediate use can eventually be made wholly usable by allowing the herds to graze into them gradually from adjacent more open areas.

The value of the different kinds of range forage plants varies greatly with variation in the associated plant species, the stage of growth, the region, and the tastes of the individual goats.

### Browse

Browse furnishes most of the forage for goats on the ranges. During the summer, browse and grass are often grazed in approximately equal quantity, provided about equal amounts of palatable species of both make up the forage. In the winter, however, browse is the principal goat feed, and it is absolutely necessary on any winter goat range which is subject to continued snow. Evergreen browse species are of value throughout the year, but are ordinarily grazed most during the winter. Deciduous species are of greatest value during the summer, but twigs and buds of such species often furnish much winter forage.

Browse should be available on kidding ranges, to provide buds, fresh leaves, tender twigs, and variety in the feed, which are fundamental requirements, especially when the growth of grass is deferred by drought or late season.

Nearly all species of browse in the United States are grazed to some extent by goats, though certain species are of much greater value than others. Important browse plants of high palatability for goats are the species of mountain mahogany (*Cercocarpus* spp.), bluebrush [3] (*Ceanothus integerrimus*) of the Pacific coast, Fendler ceanothus (*C. fendleri*) of the Rocky Mountains, fendlera (*Fendlera* spp.), bitter brush (*Purshia tridentata*), and service berry (*Amelanchier* spp.).

The oaks (*Quercus* spp.), while generally not eaten as readily as the above species, are probably the most important browse plants for goats in the West. Some species are available usually in abundance on nearly all ranges. The evergreen oaks are of great importance throughout the entire year. The deciduous oaks are of value chiefly during the summer.

The berries of the junipers and cedars (*Juniperus* spp.) and the nuts of piñon (*Pinus edulis*) are eaten readily by goats; but conifers as forage for goats are of low value and, as a general rule, are not

[3] Also called wild lilac, sweet birch, and white birch.

heavily grazed when there is a sufficient amount of more palatable browse available. Frequently, however, on overgrazed goat ranges there is considerable injury to conifer reproduction.

### Grasses

It is essential to have grass available for does at kidding time and during the summer, to provide succulent forage so that there may be an adequate supply of milk for the kids. Young kids also receive much nourishment from grass forage.

Many grass species are of high value for goats during the summer and give an excellent "finish" to the flesh of those which are to be sold for meat in the fall. As grass becomes coarse and tough in the fall it becomes less palatable to goats, and generally from this time on through the winter it is grazed very little.

Where grass grows scattered in dense brush stands it is more closely grazed than where it forms a considerable part of the forage.

### Weeds

The herbaceous flowering plants, weeds as they are generally called in the West, are usually of greater palatability when green and tender than when dry. Accordingly, they furnish little feed during the winter, but are often important at other times of the year. Alfilaria (*Erodium cicutarium*) on low ranges, however, furnishes considerable winter feed. The chief value of most weeds lies in providing variety in the forage for does and kids during the spring and summer.

### Water

The amount of stock water available determines the suitability of a given range for goats, especially at certain seasons of the year. Abundant water should be available on ranges used during the spring and summer. It is not necessary to have very much water on winter ranges if snow is available. Pure, fresh water should be provided wherever possible, but in the Southwest it is often necessary to utilize rain water caught in large storage reservoirs. The goats drink this readily when once accustomed to it.

Deep wells must sometimes be drilled on southwestern ranges if there is to be a supply of water throughout the year. The cost of such operations is often prohibitive considering the amount of forage available in the locality. When this is true such areas are sometimes used only during the rainy seasons and when stored rain water can be used.

### Climate

Climate limits the suitability of range for goats through the effect of heavy rains and snows. Dry, rugged areas are generally better suited for goat grazing than wet, marshy lands. Goats seek the shelter of timber or of sheds during heavy rains. Continued cold rains may keep them unduly confined to sheds and have often caused serious losses soon after shearing where sheds were not available. Ranges subject to heavy snowfall should not be used for winter grazing unless warm, dry sheds, and plenty of supplemental feed are provided.

FIG. 12.—Goats grazing in the open-brush type of the lower elevations on winter range

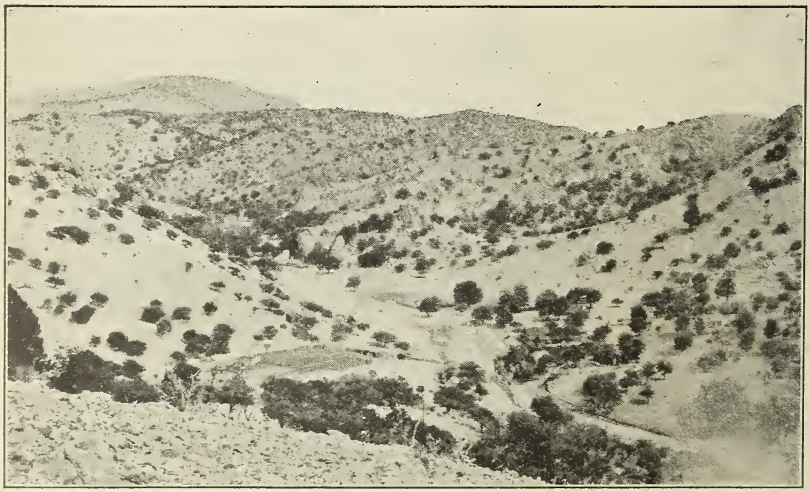

FIG. 13.—Goat range used from the headquarters ranch throughout the year for a number of years

## MANAGEMENT OF THE ANGORA GOAT RANGE

Most goat ranges are used throughout the year. It is important, therefore, to stock the range conservatively so as to assure adequate feed in poor years as well as in good years, to divide the range so as to afford the best of feed during each season of the year, and to obtain as nearly even utilization of all parts of the range as is practicable.

### Range Capacity

The true grazing capacity of a range area is the number of animals which may be carried on it for the desired season, year after year, without injury to the important forage plants and with assurance of sufficient palatable feed for the goats. An average of approximately 4 acres of the grass-brush type and from 3 to 6 acres of the true-brush type, depending upon the palatability of the browse species, should be allotted to each goat for yearlong grazing. This is for normal utilization of the forage by goats when they are grazed alone under good management and kept in good growing condition. So many varying factors, however, enter into the grazing capacity of every range that, even though goats are allotted a carefully ascertained area, the range should be watched at all times and the number of goats adjusted to the available forage.

Ordinarily not more than 80 to 90 per cent of the total herbage of the palatable grasses should be utilized by goats at the end of the grazing season if such vegetation is to maintain its vigor. Likewise seldom should more than 80 to 90 per cent of the readily available leafage of the more palatable browse species or more than one-half the current year's growth of stems of such species be utilized at the close of the grazing season. When utilization to this degree is obtained many plants of lower palatability will be grazed to a much less extent. To attempt to obtain greater utilization of the plants of low value would result in overgrazing the more palatable plants with injury to the range. Furthermore, to graze the more palatable species to the degree indicated several times during the season is sure to result in injury to the range.

The most prominent signs of overgrazing are a reduction in the quantity of palatable forage, an increase in the nonpalatable plants, a stubby appearance in the browse species, an increase in the number of rocks showing above the soil, and a thinness of the goats due to insufficient nourishment. Signs of overgrazing which are not so readily noticed, but which should be watched for, are the failure of palatable species to flower and fruit, the removal of most of the leaves of important palatable browse species before fruiting, and the covering of considerable grass on slopes with sliding soil brought down by trampling.

If any of these conditions prevail, steps should be taken immediately to stop the overgrazing. The overgrazed areas should be protected from grazing until after seed maturity of the main forage plants, excessive concentration of grazing should be stopped, and the goats should be handled as openly and quietly as possible. If this fails to eliminate the overgrazed condition, there are too many goats grazing the area allotted to them, and either the number of goats should be reduced or the area increased so that sufficient forage will be provided.

Plenty of fresh, palatable feed reduces the death rate and has a marked beneficial effect upon the mohair production, the growth of the goats, and the proportion of kids raised. Two does in good condition producing 4 pounds each of high-class mohair may yield a greater net revenue than three does in poor flesh producing only 3 pounds of mohair each. Therefore, instead of overstocking a range with a large number of low-grade goats, high-grade goats should be grazed to the number the range can conservatively carry. The net revenue will be just as great, if not greater, and the probability of occasional heavy losses will be largely eliminated.

### Division of Range for Seasonal Use

Even when a range as a whole is stocked in accordance with its true range capacity it is important to work out a plan of grazing which will give the vegetation a chance to grow sufficiently to maintain itself. To do this on an area which is grazed throughout the year necessitates light stocking, at least during the main growing season of the important forage plants. Investigation and practical tests have shown that a better plan is to divide the range into three areas, one for spring, another for summer and fall, and a third for winter. Dividing the range for seasonal use so as best to meet the needs of the forage and of the goats and distributing the grazing more evenly over the range make possible the maintenance of the forage under heavier grazing and the reservation of suitable feed for the most critical periods of the year.

### SPRING RANGE

During the period of kidding and immediately afterwards more than during any other period of the year the does and kids need plenty of green, tender feed and plenty of water. For this reason there should be an abundance of grass and weed forage on the kidding range, but there should also be some browse to provide tender, green twigs in case drought or a late season prevents a sufficient growth of grass.

It is important that this vegetation be kept thrifty, so that growth will start promptly and vigorously as soon as weather is favorable in the spring. Where the range is used from the kidding corral by large herds during the greater part of the year, much of the choice forage is killed out or is greatly delayed and is scanty when it does come. As a result the does have to travel too far, are not sufficiently nourished during kidding time, and fail to provide ample milk, and also to mother their kids properly. Under such conditions there is considerable trouble in handling the flock during kidding, and it is difficult to keep down the losses.

It is necessary to graze the does continuously from the kidding corrals during the kidding period and for two or three weeks after the close of kidding. Only strong, vigorous plants which have stored considerable food material in their roots during the growing period of the former year can withstand such continued, premature grazing. Accordingly, the does and kids should be moved to the summer and fall range just as soon as possible, so that the plants on the kidding range will have an opportunity during the summer growing season to make sufficient growth to insure an early, vigorous growth the following

spring. If the goats are moved shortly after kidding, and are not grazed on this spring area until the next spring, the plants will recuperate during the summer from the heavy early spring grazing and there will be no deterioration in the range forage.

The spring range should have enough forage so that the goats will be properly nourished during the period they are on it and no part of it be overgrazed. If there is surplus forage in the fall, it may be possible to graze it lightly, but care should be taken to see that the grass and weed forage is not grazed so much as to injure it and that the buds of the brush are not consumed.

It is best to refrain from grazing the kidding range during the winter, and under no circumstances should the winter grazing on this range be more than very light.

### SUMMER AND FALL RANGE

When the does and kids are removed from the kidding range they should be taken to the range set aside for summer and fall use. Since the kids depend largely upon their mothers' milk and upon green, succulent food for nourishment during the summer, there should be plenty of grass and weed forage on the summer range. Such forage, when young, may be injured by grazing. The forage, therefore, should be as far advanced as possible when grazing begins.

On the summer range it is necessary to graze the plants during their principal growing period and while they are producing their flower stalks and seed. The summer is also the most successful period for establishing seedlings. A normal plant growth, the production of fertile seed, and the establishment of seedlings are most important; and the goat grazing should be adjusted so as to interfere as little as possible with these plant functions.

Continuous close cropping of the forage during the growing season removes the leaves of the palatable species as fast as they are produced. If the roots are not killed by starvation, they are often trampled out of the ground by the goats' hoofs. Hence the palatable species fail to reproduce and gradually disappear; and the unpalatable species, having a greater chance for growth and reproduction, gradually take the place of the palatable species. A very open stand is formed. Erosion follows, the valuable surface soil is washed and blown away, and reestablishment of the palatable forage cover is made most difficult.

This denuded condition prevails especially where grazing has been excessively concentrated around bed grounds used every night throughout the growing season. It is important, therefore, that goats be bedded in any one place for only a short period. This will not only eliminate the concentration of grazing but will also secure a more uniform utilization of all the range forage.

If the forage is given a complete rest, or is only lightly grazed during the growing season, the palatable vegetation has an opportunity to make normal growth. With normal growth fertile seeds are produced, the seedlings are given a chance to become established, and an appreciable increase in the palatable vegetation may result.

When overgrazed goat range is given a rest during the growing season and not overgrazed at other times, the grass recuperates readily. (Figs. 14 and 15.) The brush recovers more slowly. When the

FIG. 14.—Range grazed by goats continuously for over 30 years

FIG. 15.—Same range as shown in Figure 14 after protection from goat grazing during part of the growing season for two years

range has been only lightly overgrazed the brush also recuperates readily with protection, but if the range has been badly overgrazed it is several years before the brush makes its normal growth.

### DEFERRED AND ROTATION GRAZING

When range is fully stocked it is not always possible to allow all the summer range a rest from grazing during the growing season. If the winter range and the summer and fall range can be interchanged advantageously each of these divisions can be given protection in different years; but it is often impossible to interchange them because snow prevents winter use of the range reserved for summer and fall. It is unnecessary, however, to give the entire summer and fall range a rest from grazing during the growing season. If it is stocked so as to prevent overgrazing, and if grazing is deferred on successive parts until after seed maturity and then the surplus forage is utilized, all of the forage may be fully grazed and the vegetation maintained in a state capable of maximum production.

The average summer and fall goat range is grazed from about June 1 to November 1, or approximately five months. The greater part of the principal forage species have matured seed by September 1. Grazing then, should be deferred on certain successive parts until some time after this date.

The simplest plan would be to divide the summer and fall range into five parts of equal grazing capacity, each part suitable for a month's use. Two parts could then be protected from grazing until after September 1 each year. Each part grazed in any month for any given year should be grazed a month earlier in the succeeding year, except the part grazed first which would then be grazed last. For example, if the parts are designated by A, B, C, D, and E, in any year, A, B, and C may be grazed during June, July, and August, respectively, and D and E left to be grazed in September and October after seed maturity; then in the succeeding year, B, C, and D would be grazed in June, July, and August, respectively, and E and A left to be grazed in September and October, and so on. This would allow the forage on the part grazed last each year a second year of protection until after seed maturity, and would give the seedlings from the first year's crop of seed a good chance to become established. Such a grazing system results in a 5-year rotation with each fifth of the range being given protection from grazing until after seed maturity two years in every five. In practice, especially on relatively small ranges of high capacity, it is not always possible to hold a large herd on one-fifth of the range during a month without injury to that part of the range. Equally good or better results are therefore obtained if grazing is evenly distributed during the whole period of June, July, and August over the three parts to be used at that time in any one year, and likewise evenly distributed during September and October over the two parts reserved for deferred grazing in those months.

### WINTER RANGE

To reduce the feeding to a minimum and to decrease the liability of loss, the winter range should be situated low enough to be out of the

area of severe storms. It is also essential that enough forage be protected at other times of the year so that the goats may obtain ample feed during the winter without excessive traveling. The browse areas at the lower elevation generally furnish the best winter forage. Practice has shown that it is best to reserve the feed close to the shed for use during heavy snows and after shearing in the fall or late winter. In order to preserve this feed and prevent overgrazing, and still have the goats close enough to the shed to be brought in if a storm threatens, the goats may be bedded at a number of places about half a mile in different directions from the shed.

### Rodents

The amount of forage available for goats may be greatly reduced by rodents such as prairie dogs, ground squirrels, pocket gophers, and jack rabbits. This frequently amounts to one-quarter to one-half the possible feed production on an area, and at times more than three-fourths of the grass is destroyed. To the extent that such damage occurs, the carrying capacity of the land for livestock is reduced. At times kangaroo rats and field mice do extensive damage also.

Where any of these animals occur in sufficient numbers to materially reduce the feed supply it pays to destroy them by poisoning. This can be done at a cost much less than the amount of loss caused during a single year. As methods to be employed vary greatly according to the particular animal, the locality, the season, and natural feed available, those interested in such control work should get in touch with the Bureau of Biological Survey, Washington, D. C., or its local representatives.

### Coordination of Range and Ranch

Most goat ranches in the range coutry, especially in the Southwest. consist of the headquarters, kidding and shearing facilities, and sheds for winter protection. Very little provision is made for feeding, except for the feeding of cottonseed meal, which is fed during critical periods only. The range forage is largely depended upon for sustaining the herd.

In nearly all parts a greater production of harvested crops is warranted. If goats are allowed to become thin during the winter because of inadequate feed, they are made more susceptible to disease and starvation; satisfactory mohair production is impaired; and the kid crop is materially lessened. Does, especially, should be kept in a thrifty condition throughout the year. If there is danger of inadequate range feed, plans should be made to provide sufficient hay, silage, or some concentrated feed to supplement the rations of the more valuable and the more impoverished animals.

### Feeding Goats

While goats relish a larger proportion of browse than sheep, yet they enjoy some lush weeds and choice grass. Supplemental forage such as oats, rape, grain sorghums, etc., will be found satisfactory as feeds where they can be grown economically. If both range and pastures fail, legume hays such as alfalfa, clover, cowpea, or soy-

bean, and a limited allowance of grains such as oats, corn, or the sorghum grains are just as suitable for goats as for sheep. A daily grain ration per goat will vary from one-fourth to 1 pound, or in extreme cases to a maximum of 1½ pounds.

Abrupt changes in feed for Angoras should always be avoided. Starvation, overfeeding, or quick changes from rations of one kind to another are very likely to have detrimental effects on the strength and quality of the mohair.

### MANAGEMENT OF THE RANGE HERD

The management of the goats on the range is closely associated with the management of the range and determines largely whether they will show a profit or a loss. The effect on the forage is reflected

FIG. 16.—Scene on an Angora goat ranch in the Northwest

in the growth and production of the animals using the range. In addition, methods of handling affect the animals directly. Bad management of goats on the range may offset all the good effects of careful range management and careful selection of the breeding herd.

#### GRAZING IN PASTURES

If pastures are available, the management of goats on the range is much simpler than herding on unfenced range. In wolf-proof pastures goats may be turned loose and only watched sufficiently to avoid losses from accidents, disease, or other causes and to assure adequate attention at breeding, kidding, and other special times. The goats will graze singly or in small groups, grazing, resting in the shade, and bedding, as they desire. If the range is not overstocked, best results will be obtained from pasturing rather than herding.

### Size and Composition of the Range Herd

On the range, goats are grazed in herds of from a few hundred head to over 2,000. General range practice has shown, however, that it is most economical on timbered mountain ranges to graze goats in herds of approximately 1,200 head of mature animals. Herds of this size produce the most satisfactory results. With herds of less than 1,200 average range costs per goat are usually greater, and with herds of more than 1,200 grown animals more care is required in herding, and a greater number of bed grounds must be used to keep the goats in good condition and avoid damage to the range. On untimbered, relatively level range a greater number of dry goats may be grazed in a herd.

The breeding does should be grazed separately from the dry does, wethers, yearlings, and weaned kids. This allows the does to graze more quietly while with their kids and insures their being in better condition, which is especially important at breeding and kidding times. Range kids should be weaned at about 5 months of age. Buck kids older than this should never be allowed to run with the does, as they will often breed and otherwise cause much annoyance to the does. Wethers also annoy does at breeding time, and just before kidding may worry them sufficiently to cause abortions.

### Herding

Small herds of a few hundred head or less may be watched successfully by a well-trained dog if there is an abundance of good range for the goats; but when the herds are large, and the range fully stocked, a herder is absolutely necessary on unfenced range to secure proper utilization of forage, and to prevent trailing of the goats and loss from straying, accidents, and predatory animals.

The goats should be grazed slowly, quietly, and openly, and the leaders should be held down to the rate the rear goats desire to take. As the goats leave the bed ground in the morning the leaders should be turned in the direction the herder wishes to graze the goats that day. Throughout the morning they should be allowed to drift slowly away from the bed ground. In the warm part of the day most of the goats will take shade under trees and bushes, but a few may graze intermittently during the entire day. In the late afternoon the leaders should be turned into the herd and started toward the bed ground selected for the night. By taking the goats back over the same area grazed in the morning it is possible to pick up any goats that have remained behind because of failure to herd them carefully enough.

Ordinarily goats should be taken from the bed ground early in the morning and returned about sundown. However, on ranges where there is danger of foot rot, it may be best to avoid wet grass by holding the herd on the bed ground until about 7 a. m. Goats can not secure sufficient feed when driven over the range for only a few hours during the middle of the day. Accordingly, it is poor practice to hold them on the bed ground until late in the morning or bring them in early in the afternoon. Goats graze more quietly in the cool of the morning and evening and thrive best when allowed four or five hours of quiet grazing at each of these periods

and a rest on the range from an hour to several hours during the heat of the day.

### Bedding

Many herds of goats, regardless of size, are bedded in a corral at the main ranch throughout the entire year. Some growers, having observed the detrimental effects to range and goats of such a method, have used more bed grounds. However, this is only a step in the right direction. When just a few bed grounds are used with large herds there is considerable concentration of grazing, which may prevent proper growth of the goats. Range practice has shown that the more bed grounds used the greater the benefits to range and goats.

The use of a number of bed grounds at different places on the range aids materially in securing more even utilization of the forage over the entire allotment, lessens the concentration of grazing, and makes possible the recuperation of the overgrazed areas and the utilization of each part of the range at the most advantageous time. The improvement in the quality and quantity of the forage and the reduction in trailing and driving of the goats result in better growth of goats and mohair.

It is seldom possible to apply successfully the principles of improved goat-range management when only a few bed grounds are used. The use of many bed grounds, however, makes possible the application of these principles. When a bed ground is used for only a short period, the goats can be quietly grazed close by throughout the day. The longer a bed ground is used the greater distance it is necessary for the goats to travel for fresh feed. When a bed ground has been used a week, the feed around it is dirty, and since goats are fastidious animals they trail over much unused, soiled feed. The increased trailing is apt to cause overgrazing, at least to some extent. Just as soon as overgrazing begins to take place and the goats must either graze the less palatable species or travel farther to obtain more palatable feed, they will lose flesh, and the growth of mohair will be impaired.

### Bedding-out system

The bedding-out system, which is followed successfully with sheep on western ranges, is the ideal bedding method toward which growers of goats should work. Under this system the goats would be bedded wherever night overtakes them. Open, quiet herding would be practiced, and the goats would be allowed several hours of quiet grazing in the cool of the morning and the afternoon and a rest in the middle of the day.

The bedding-out system can not be strictly adhered to during kidding nor during periods of stormy winter weather, nor just after shearing, but its use at other times of the year is practicable and reserves the feed on the kidding range and near the shed for critical periods.

If the bedding-out system is used and the range properly managed, the maximum of forage is produced, forage is utilized to its best advantage, overgrazing is eliminated, and the goats have fresh feed at all times. This makes possible the grazing of a greater number of goats and secures greater production of meat and mohair. The

mohair is cleaner and of better quality, which materially increases its value. The percentage of kids raised also is greater because the does are maintained in good condition, which is of especial value at breeding and kidding time and during the winter while the fetus is developing.

### Watering

How often goats are watered depends largely on the availability of stock water, the weather, and the nature of the forage. If the dew is heavy, the forage succulent, and the weather cool, goats can go without water for several days. When snow is available in winter they can go without water for longer periods. When the forage becomes dry and the dews are light, wethers and dry does should be watered at least every other day and does with suckling kids should be watered every day.

Goats should be bedded away from water and grazed quietly to and from it. They should never be driven hurriedly to it, nor allowed to "shade up" at water, nor be held there for more than an hour. An hour is usually sufficient time for them to obtain all the water they need. Often greater use of the range is made by bedding the goats away from water than would be possible if the goats were bedded at the few watering places. The success of this plan depends to a great extent upon the topography of the range, the presence or absence of enough water for camp use away from the stock water, and the cost of transporting water for camp use when there is not enough.

### Salting

Goats are more easily handled and thrive better if salted regularly at short intervals than if salted at long intervals. Rock salt is often placed on the bed ground, so that the goats can eat of it every night if they desire. Coarse granulated salt is fed either in small quantities every night or in larger quantities at intervals of approximately a week. It is ordinarily placed on rocks, in troughs, or in boxes to prevent waste and to keep it clean. It is believed best to feed every night, giving just the amount the goats will eat. If salt is fed at great intervals or if rock salt is used, the goats are apt to crowd and injure one another.

Medicated salt is fed by many growers with success, although some growers think that it may cause the goats to shed if fed too freely in the spring.

On most goat ranges 3½ to 4 pounds per goat per year will prove to be most satisfactory. A greater amount should be fed when the range is green and succulent than when it is dry. Ordinarily it is best to feed plenty of salt rather than an insufficient quantity.

## EQUIPMENT FOR GOATS

In the goat-range country of the southwestern part of the United States, sheds, though they are of only simple construction, are very desirable as a means of protection, especially when cold rains and sudden changes in temperature occur just after shearing or during

the kidding season. (Fig. 17.) At times the lack of shelter during cold, stormy weather results in disastrous losses, and a moderate investment in ample emergency shelter is ordinarily profitable. Lumber is seldom abundant on the goat range, but low sheds may be economically built by using metal roofing and boarding up one or two sides so as to furnish protection from the prevailing winds. In the southwestern range country at least 4 or 5 square feet of floor space per animal should be provided for goats; otherwise, there is danger of having them pile up and smother in time of storm. Goats should not be housed too closely and should be kept in sheds only when necessary so as to keep them fit to withstand ordinary extremes of temperature. However, many of the best equipped goat ranches of the Southwest have fly-proof sheds in which valuable animals are kept when they are infested with screw worms or are injured in such a way as to induce screw-worm attacks.

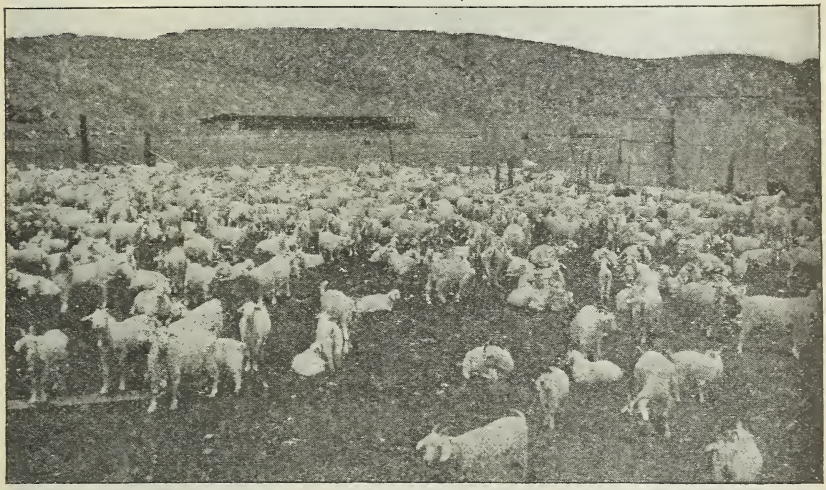

FIG. 17.—Angora goats and ranch equipment, Yavapai County, Ariz. Desirable goat range in the background

In cold northern climates barns or closed sheds are necessary to protect Angoras from the extremes of cold and storm. When the animals must be housed every night more floor space is needed than the 5 square feet per goat above suggested for the southwestern range country; at least 8 to 10 square feet per head is recommended for the proper care of the goats under the conditions of northern winters. Dry quarters and well-drained land are just as important for goats as for sheep.

It is customary on the range to make the corrals with brush pickets secured with wire in such a way as to form a tight stockade. Another method of making wolf-proof fences is to use 36 or 42 inch woven-wire fencing for the lower part and two strands of barbed wire on top spaced so as to make the total height of the fence about 50 to 56 inches. A barbed-wire fence that would be goat proof should have at least eight barbed wires and a height of not less than

4 feet. Careless fencing against goats usually results in their forming troublesome fence-breaking habits. The woven-wire fencing should be of 12-inch mesh, for Angora goats will put their heads through and get hung up in fencing of 6-inch mesh.

## BREEDING

In order to make the most of the hereditary material represented in the herd and to use the laws of nature to the best advantage, it is essential to have clearly in mind a standard toward which to work. This standard must be definite and should be as practical and simple as possible. The constant selection of a good type will increasingly

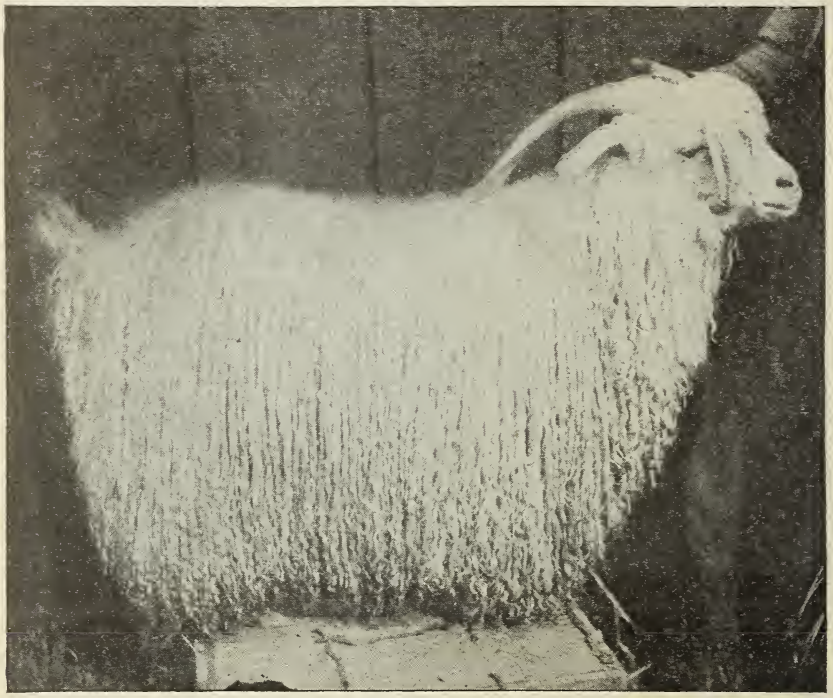

FIG. 18.—A good type Angora buck

intensify the properties of a given set of characteristics, but this selection must be pursued constantly. Figure 18 shows a good type of Angora buck for breeding purposes. Our modern breeds are an improvement over the stock from which they sprang originally, and there is a constant pull backwards and downwards, against which the breeder must work by wise selection and judicious matings. If this intelligent direction by human skill should be removed, our animal stock would rapidly degenerate.

Selection should be designed to correct faults in the parent stock, and as a rule the male is depended on to accomplish this. A sire should, therefore, be a better individual than the females with which he is to be mated; otherwise the standard of the herd may decline.

In males evidence of strong masculinity is important. This evidence of masterful impressiveness of the masculine sex is often apparent in very young animals and may be taken to indicate a youngster that with proper feed and care will grow out into an impressive sire. In females, we look for femininity without indications, however, of weakness of constitution. The breeding animal should look the part; a poor male should never be purchased even though he has a good pedigree.

The proof of the value of the pedigree itself is the worth of the animals it produces and their ability to produce desirable types with greater excellence and uniformity than animals with other pedigrees or with no known pedigree. If the matings which have produced the pedigreed animal have not been directed by a high order of skillful selection, the resulting animals may not have intensified the desirable types.

The period of gestation for Angora does varies from 147 to 155 days. As a rule does come in heat only during the late summer, fall, and early winter. The time of year to breed the does varies for different parts of the country, but as March and April are the months in which most of the kidding occurs, the breeding season is chiefly in the months of October and November. The primary factor which should determine the time to breed is the feed supply. The weather and shelter conditions that can be expected about five months after the mating season are also very important. Favorable conditions for kidding are highly essential for the profitable production of a kid crop.

It is advisable under normal conditions to have the bucks remain in the doe band for a period of about 40 days. In that length of time there is opportunity for breeding does at their second heat period if they fail to conceive at the time of the first one. Unless the bucks are with the does at least 40 days, there is danger of having an abnormal portion of the does fail to bring kids the following spring.

Just before the breeding season, the long mohair that would interfere with effectual mating should be clipped from both bucks and does. Bucks should be at least 18 months old and vigorous, and the does should not be allowed to breed until they are 18 months old. The exact number of does per buck depends on the age and vigor of the bucks, but about 30 to 50 has been found to be a satisfactory ratio.

Good feed, care, and attention are valuable adjuncts to selection. Proper feeding permits full development. It is impossible to select intelligently the animals which have received and can transmit the characters it is desired to perpetuate unless they have been properly fed. Starved animals, which have never had an opportunity to demonstrate their full capacity to produce either mohair or meat, furnish poor material from which to select individuals capable of maximum and most economical production.

The food an animal eats has a remarkable effect on its development, especially when it is young, and the younger an animal is the more readily is it influenced by food. From the very instant that growth begins with the fertilization of the egg and the young animal begins to develop it must receive nourishment from some source or die. Even when it is only a single cell it is being fed. If, after birth, a young animal is greatly influenced by its food, how much more will the delicate little fetus or embryo be influenced by the character of

its food supply? The breeder who recognizes this fact clearly and acts in accordance with this recommendation will not neglect proper attention to the nourishment and care of the pregnant mothers as well as the nursing animals.

The plan of feeding the bucks by themselves each day during the breeding season helps to keep up their efficiency and capacity for service. The best range available should be provided for the doe band over a period beginning about two or three weeks before turning in the bucks and lasting through the breeding period. Good feed for the does at that time helps to insure uniform and satisfactory conception.

## KIDDING OPERATIONS

An efficient system of kidding is one of the most important means of contributing profits to the enterprise of goat production. On well-managed ranches the staking or toggle system is frequently

FIG. 19.—Kids numbered and toggled on the range

used, and some producers use individual claiming pens for safeguarding against having does disown their kids. In the use of the toggle system the stakes are usually placed about 10 feet apart throughout the kidding yard. The yard should be large enough to allow for a 10-day kidding period and to provide room for spacing the stakes at the distance of 10 feet so that each kidding doe will have a stake of her own to which her kid will be fastened. This necessitates a rope about 15 inches long, having a swivel and a simple leather loop for attaching to the fetlock joint of the kid. (Fig. 19.) Each kid should have a box for shelter from rain and excessive sunshine. A very satisfactory kidding box can be made of boards cut 12 inches square, leaving one side of the box open. A-shaped boxes are often used, but they do not keep the kids off the ground and they are more easily broken with hard usage. Figures 20 and 21 show two common types of kidding boxes

Good draining is essential for best conditions in the kidding yard. This will usually necessitate a slope to the ground, and as the older does will naturally spend the night at the upper side of the yard

their kids should be staked there and the kids of the young does at the lower side. By this arrangement there is less danger from having the older does drive the young does away from their kids than would be the case if old and young does were not separated. Does

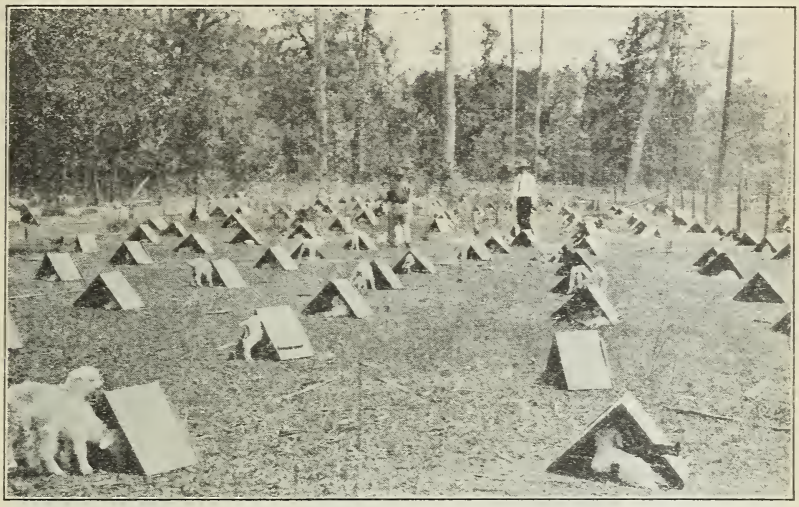

FIG. 20.—Toggled kids in the shade of their individual shelters

that are especially quarrelsome should have their kids staked out at one end or at the edge of the yard. On cold, rainy nights it is a good plan to keep the does confined or entirely out of the staking

FIG. 21.—Yard scene showing common type of kidding box, Sutton County, Tex.

yards, as confusion from does passing about the yard will result in many of the kids coming out from their shelter boxes into needless exposure.

Does that are likely to kid during the daytime should be kept at camp, where they can be given proper attention. For this pur-

pose a fresh bit of fenced range or pasture is very helpful for keeping the kidding does properly nourished and contented.

Great care must be exercised when does drop their kids on the range because of the danger of having some does leave their kids and follow the band. When carrying newborn kids to camp the attendant should be careful not to allow the kids to rub together as the odors thus exchanged may cause the does to disown their kids.

When a doe disowns her kid she should be staked with it. A practice of staking every doe with her kid for at least 10 hours immediately after she kids has proved to be a good means of keeping does well attached to their kids. In case a kid dies, the mother should be immediately staked with a young orphan or an undernourished twin kid. A doe may be most efficiently persuaded to own an orphan

FIG. 22.—Young kids should be provided with shade

if she is confined with the kid in a small individual claiming pen until the orphan is adopted.

A good system for keeping strict account of the kids and the mother of each is to give each kid and its mother a distinct paint brand or number; that is, the same brand number or character should be placed on both the doe and her kid and enough numbers or characters should be used to avoid duplication among the does of a given group. By this process a doe that would disown her kid can promptly be located and brought back to the kid.

Careful herders keep a close watch to be sure that every kid is suckling. If a kid looks gaunt and restless and is found nibbling at the ground its mother should be taken to it so that the kid can suckle. If a doe has a distended udder, the kid branded with her number should be examined. In the case of a doe with extra large teats it may be necessary to help her offspring nurse several times until it learns how to suck the abnormally large teat.

As a rule kids should not be kept on the stake more than 10 days. When they are 10 days old they ought to be worked out of the staking yard into a field where they can get more exercise. Young kids should be provided with shade. (Fig. 22.) When about 6 weeks old the kids can begin going to the range with their mothers. Under especially favorable conditions not requiring long trails, kids that are vigorous may go directly to the range with their mothers upon being released from the stake. In the Southwest, especially in Texas where the does and their kids are handled in fenced pastures, it is essential, while the kids are young, to round the does and kids up every day or two in order to be sure all the kids are nursing properly. On the range an 80 per cent kid crop is considered a very good yield.

Some growers have found the pen system (fig. 23) of kidding as advantageous as the toggle system. In the pen system the does and

FIG. 23.—Kids in the handling pen, adjoining the individual kidding pens

kids are worked out of the individual kidding pen into small pens, the kids of the same age being grouped and the older and younger does. Each day the does are allowed to go out onto the range for grazing and are cut through a chute into the pens in the evenings. After several days in the small pens, the does and kids are worked into a larger pen, generally termed a mixing pen. When the kids are 10 to 15 days of age they are worked out into a still larger pen, since by that time there is little danger of the does failing to own or find their kids.

## SHEARING

In the spring, goats should be sheared as soon as the weather permits and when all danger of cold rains has passed. If they are shorn too early they become exposed to possible cold spells which may retard the growth of the mohair and cause serious losses through sickness. In the Southwest, on account of the warmer cli-

mate, goats are shorn twice a year, in the spring and in the fall. Shearing should be done only when the mohair is dry, and it is well to leave some hair on the goat's back to help protect it from possible extremes of weather. It is best not to shear immediately following a heavy rain but to allow the fleece to dry before shearing. Moisture in the fleeces when shorn may subsequently damage the mohair for, if it is packed while it is still wet or damp, the moisture evaporation is very slow and during this time a heating action may take place which would weaken the fibers considerably.

The goats should be shorn on a smooth dry surface, preferably on a board floor. Care must be taken at all times to keep the mohair free from straw, chaff, dirt, or other foreign matter. When it reaches the mill, all the straw, chaff, burrs, etc., must be removed by the sorters during the process of dividing the fleeces into the different qualities. It takes considerable time to remove this dirt and trash found in the fleeces, and its removal causes unnecessary additional expense and reduces the value of the clip.

Goats are shorn either with hand shears or with machine clippers. Before shearing the body of the goat, all tags, dung locks, and stained pieces should be removed. These sorts should be packed separately. It is advisable to pick out before shearing, if possible, any foreign matter in the fleece. The fleece should be kept intact during the shearing because the unbroken fleece is much easier to open and sort after it reaches the mills.

When using hand shears, be sure to clip with the blades level with the body of the goat. Second cuts should be avoided, for they shorten the length of the staple and reduce the value of the mohair. When clippers are used, they must be adjusted so as not to cut too close to the skin, for cutting too close may cause undue exposure to the hot rays of the sun and the goat's skin may become blistered, with consequent danger of annoyance and infection from blowflies before the mohair makes the growth necessary to protect the skin. The skin of the animal should be stretched at the part being shorn, as this helps to prevent cutting or mutilating the goat and also aids in securing uniformity in length of staple.

### STORING AND PACKING MOHAIR

Never permit the mohair to lie upon the ground, but secure a clean dry place to store it until it can be sold. If it is stored in a damp place it will very often mold and mildew, which, with the dampness, causes a heating or sweating action which rots and weakens the fibers and renders them less desirable for the manufacture of the better class of goods and lowers their value.

The white and the black or other colored fleeces should be kept separate. Black, red, and gray fleeces will not take the lighter shades of dyes and consequently are not in such demand and sell only at greatly reduced prices. Never permit such fleeces to be packed with the white. Also keep the burry, seedy, cotted, and dead fleeces away from the clean well-grown mohair and pack them separately, for such fleeces must be handled differently before being manufactured into any material. Do not pack all kinds together indiscriminately because this reduces the net returns to the growers,

for it is very difficult to place a true value on such lots as the amount of these inferior kinds of mohair must be estimated and the price decreased accordingly.

The fleeces from kids, those from the middle-aged goats and those from old goats which have straight and coarse mohair should be packed separately. It is quite a general practice to pack the kid mohair by itself, but many growers could profit by giving more careful attention to the separation of the mohair from middle-aged goats and that from old, straight or coarse-haired goats.

Sisal or any loosely twisted twine is particularly objectionable for tying fleeces, as the vegetable fibers often become intermingled with the mohair. These objectionable vegetable fibers often pass the sorter unnoticed and may undergo several manufacturing processes before being detected. They show up very prominently, however, after the goods have been dyed and cause a considerable reduction in the selling price of the finished material, a circumstance which is bound sooner or later to be reflected in the price paid to the mohair producers. Manufacturers particularly desire that no string of any kind be used on mohair fleeces.

## LOSSES AMONG GOATS

### POISONOUS PLANTS INJURIOUS TO GOATS

While there have been many reports of injury to goats by poisonous plants, and although some of these reports have been made by accurate observers, there is, after all, very little definite published evidence in regard to the effect of poisonous plants upon these animals. There has been much experimental work done upon horses, cattle, and sheep but practically none upon goats. This has doubtless come about because of the greater importance of cattle, sheep, and horses in the United States and because of the very heavy losses which have occurred among these animals, particularly in the western part of this country.

There apparently is a popular idea that goats are less likely to be affected by poisonous plants than are other animals. It is a matter of much doubt whether this is really true. It seems probable that the plants which are poisonous to sheep will have a similar effect on goats. It is possible that goats, because of the localities in which they graze, and the manner of their feeding, confining themselves more largely to browse, are less likely to eat large quantities of poisonous plants than are the sheep; but until there is real cause for thinking differently, it may be assumed that if goats eat as much of these plants as do sheep, they will be affected in much the same way.

In making the following list of poisonous plants, there have been included not only those which are known to affect goats, but also others which are known to be poisonous to sheep, and which, in all probability, are also injurious to goats. It has seemed wise to include these possibly poisonous plants, in order that those raising goats may be on their guard and thus may prevent possible sickness and death in their herds. No attempt has been made to compile a complete list but to mention only those which may be considered as especially important. The arrangement is alphabetical, for the most part according to the Latin names of the plants.

### Acorns

Acorns have long been known to poison cattle, and there is good reason to think that they are responsible for some very heavy losses of sheep. It would be wise to take precautions to prevent goats from eating any large quantity of them.

### Aplopappus

There are at least two species of these rayless goldenrods, *Aplopappus fruticosus* and *A. heterophyllus* (fig. 24), which have been proved to be dangerous to sheep. These plants grow sometimes in considerable quantity in western Texas, New Mexico, and Arizona and cause in sheep and cattle the disease which is known popularly as "alkali disease," or "milk sickness." Inasmuch as it has been

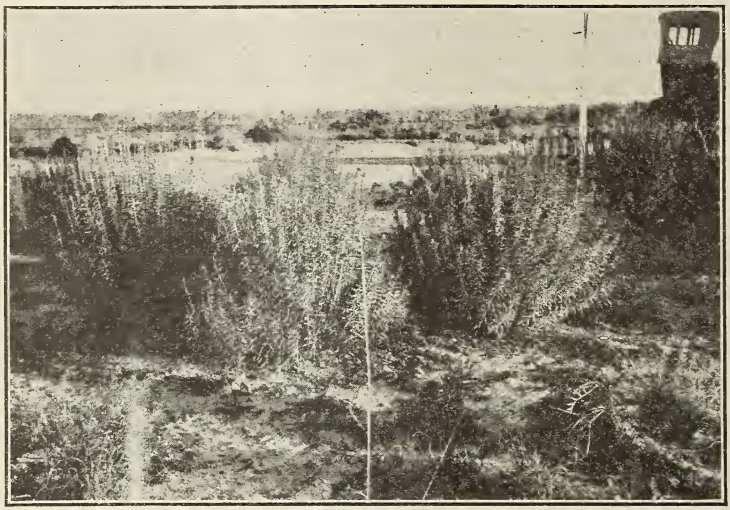

Fig. 24.—*Aplopappus heterophyllus* (rayless goldenrod), the cause of milk sickness in southwestern United States

shown that the poison of these plants can be transmitted through the milk, it may be assumed that it is dangerous especially for milk goats to feed upon these plants.

### Asclepias

Under Asclepias is included a number of species of milkweeds. Comparatively recent work has shown that several of these are extremely poisonous. Of the poisonous species, *A. galioides*, whorled milkweed (fig. 25), is perhaps the most widely distributed, being found in Colorado, Utah, Arizona, and New Mexico, and is an exceedingly poisonous plant. It is well for stockmen to become acquainted with this plant and keep goats from grazing it. Further west is another whorled milkweed, *A. mexicana*, which extends into California and farther north, and is almost equally dangerous. In California, *A. eriocarpa*, woolly-pod milkweed, and *A. vestita* have

FIG. 25.—*Asclepias galioides* (whorled milkweed)

been found to be very poisonous to sheep, whereas in the desert regions, *A. albicans* and *A. subulata* have been found to be poisonous. Some milkweeds are not poisonous, but it is safest for those who are herding sheep or goats, so far as possible, to avoid all milkweeds.

### Asclepiodora decumbens

*Asclepiodora decumbens*, commonly called "antelope horns," is a plant, closely related to the milkweeds. It occurs from Kansas to

Fig. 26.—*Daubentonia longifolia* (coffee bean) grows abundantly in southern Texas

Nevada and south, and has been shown to be distinctly poisonous to sheep.

### Daubentonia longifolia

The fruit of *Daubentonia longifolia*, known as "poison bean" or "coffee bean," which grows abundantly in southern Texas, has caused some heavy losses of sheep and goats. (Fig. 26.)

### Chrosperma muscaetoxicum

Fly poison, *Chrosperma muscaetoxicum*, is a plant with grasslike leaves, growing along the southern Atlantic coast, and occurs in considerable abundance in South Carolina. Although this plant does not grow where goats are likely to be raised in any numbers, it is perhaps worth while to mention it because of its extremely poisonous properties.

### Cicuta

Cicuta or water hemlock, (fig. 27) is considered perhaps the most poisonous of North American plants. It has been stated by some authors that goats are not poisoned by it; others have said that it poisons goats as well as other animals. As a matter of fact, it is not likely to make very much trouble, for the plant grows in damp places, frequently very abundantly along irrigating ditches in localities where goats do not ordinarily graze.

### Delphinium

The larkspurs, *Delphinium spp.*, should be mentioned here, because of their very poisonous qualities. So far as the cattle industry is concerned, the losses due to larkspur poisoning are second only to those caused by the loco plants. It is a curious fact, which has been proved, that sheep are not poisoned by the larkspurs, and it may be assumed that goats, like sheep, are not affected by them. Grazing specialists of the Forest Service have seen goats clear up a patch of larkspur without any harm whatever befalling the animals.

### Eupatorium urticaefolium

White snakeroot, *Eupatorium urticaefolium* (fig. 28), grows in the States east of the Mississippi River, being especially abundant in those along the Ohio River and in the Appalachian Mountains. The plant causes milk sickness, which has been known for many years and has been especially dreaded because it affects not only all classes of animals but also human beings, who suffer from the milk and butter produced by poisoned cows. There have been statements that goats have been poisoned by this plant, and it would seem wise for those who handle goats in the regions where this plant grows to avoid it, so far as possible.

### Karwinskia humboldtiana

Coyotillo *Karwinskia humboldtiana* (fig. 29) grows in the southwestern part of Texas and in Mexico, and is a particularly dangerous plant. It is a low bush, and the trouble from eating this plant is caused by the fruit. The plant produces a chronic paralysis, which, in most cases, is practically incurable. All classes of animals are affected by it, and the losses of goats are said to be quite heavy.

### Laurels

From the knowledge at hand, it appears that practically all the plants commonly known as laurels are poisonous to goats, as well as

FIG. 27.—*Cicuta vagans,* showing leaves and flowers

FIG. 28.—*Eupatorium urticaefolium* (white snake root), the cause of milk sickness in eastern United States

FIG. 29.—*Karwinskia humboldtiana* or coyotillo

to cattle and sheep. This evidence in regard to a number of these plants is quite definite. In the eastern United States, *Kalmia latifolia* (fig. 30), mountain laurel, has caused a great deal of trouble. *K. angustifolia*, also a narrow-leafed laurel, popularly known as sheep laurel, will poison goats. In the South Atlantic States are to be found *Xolisma ligustrina*, "he huckleberry," and *Neopieris mariana*, "stagger bush"; there are no reports of poisoning of goats by these two plants; however there is no question but that they are as poisonous as the other laurels. In the western United States are other laurels, which although not known to poison goats, should, without any doubt, be avoided. Among these are listed *Azalea occidentalis*, white laurel, and the black laurel, *Leucothoe davisiae* (fig. 31), which grow in considerable abundance in the California mountains. *Ledum glandulosum*, which is sometimes called "black laurel," is only slightly poisonous. The white Rhododendron, *Rhododendron albiflorum*, is also a dangerous plant of the Pacific slope and extends as far east as Colorado.

### Locoes

Goats, like cattle and sheep, are affected by the loco plants. Of these plants, the white loco, *Oxytropis lambertii* (fig. 32), is especially dangerous. Other locoes, however, like the blue loco, *Astragalus diphysus*, may have the same effect. Loco poisoning is particularly exasperating, inasmuch as it comes on very slowly; when once the animal is poisoned, the recovery is equally slow, and in many cases never complete.

### Lupines

There are no data in regard to the poisoning of goats by lupines. There is abundant evidence, however, of heavy losses of sheep from eating lupines at the time when the pods are filled with seeds. It is the seeds and pods that are particularly dangerous, rather than the leaves. Although some lupines are not poisonous, in lack of full information, it is advisable to avoid them all. (Fig. 33.)

### Nicotiana

The wild tobaccos have recently been shown to cause considerable losses of cattle and sheep. While, under ordinary circumstances, animals are not likely to eat these plants, where feed is very short it is possible that they may get enough to cause sickness and even death. It is to be assumed that the tobacco will effect goats as well as sheep.

### Prunus

Species of cherries are somewhat dangerous, because of the prussic acid which is produced in the leaves. The wild cherries of the West have caused very heavy losses of sheep, and some losses of goats have been reported. It should not be assumed that nibbling cherry plants is dangerous. It takes a considerable quantity of the leaves eaten in a short time to produce sickness, but when animals are poisoned death is very likely to result. (Fig. 34.)

FIG. 30.—Kalmia latifolia (mountain laurel), common in the mountains of the eastern United States

FIG. 31.—*Leucothoe davisiae* (black laurel) found in the Sierra Mountains of California

FIG. 32.—*Oxytropis lambertii* (white loco), the most widely distributed of the loco plants

FIG. 33.—*Lupinus sericeus*

FIG. 34.—*Prunus demissa*

### Solanum

It might be well to mention the species of Solanum, particularly the bittersweet and the black nightshade, although, as a matter of fact, they are not important as stockpoisoning plants. They are poisonous, and whenever animals eat large quantities of them bad results may follow, but it is not often that they eat enough to produce any harm.

### Xanthium

It has been shown conclusively that young cockleburs, *Xanthium* spp., in the cotyledon stage are extremely poisonous. There are no records of poisoning of goats by these plants, and possibly goats are not likely to feed upon them, inasmuch as they grow most abundantly on the edges of bodies of water. It is well perhaps to know that these plants are poisonous, and to make sure that goats do not


Fig. 35.—*Xanthium italicum* (cocklebur)

water at places where these plants are growing in quantity. (Fig. 35.)

### Zygadenus

The species of Zygadenus go under the name of death camas. There are several species, and most of them are poisonous. *Z. venenosus*, meadow death camas, which is found abundantly in California, grows in wet places where goats are not likely to feed. Some of the poisonous species, however, grow on dry land. There is a species growing in Oklahoma and Texas, Nuttall's death camas (fig. 36), which has occasioned considerable losses, more particularly of cattle.

Detailed descriptions of the above plants are not given, because in regard to most of them the Department of Agriculture (*12–16*) has issued bulletins in which are descriptions of the plants and of their effects, although goats are not generally included in the list of animals.

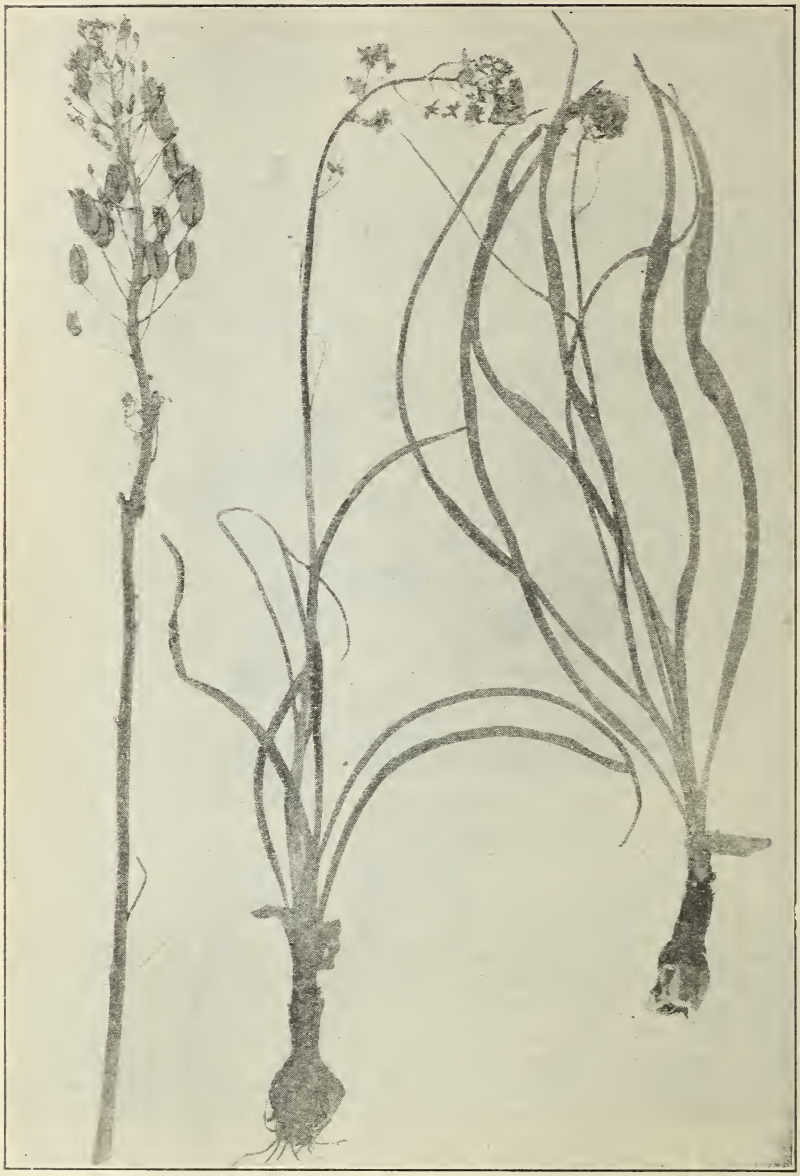

FIG. 36.—*Zygadenus nuttallii* (Nuttall's death camas), found in some abundance in Texas and Oklahoma

### REMEDIES

It is not necessary to say much in regard to remedies because the bulletins just referred to give specific directions. In general, however, it may be stated that little reliance should be placed upon medicinal measures, but care should be taken to prevent the animals from grazing largely where these poisonous plants are present in any considerable numbers. Generally speaking, anything in the nature of a laxative will aid the animals in recovering from the poison. It has been found, for example, that doses of linseed oil are very effective in the case of goats which have been poisoned by the laurels.

### PREDATORY ANIMALS

Among the predatory animals, the coyotes and bobcats are most likely to cause serious loss. The losses are especially serious when kids are young, but even adult goats are killed by these animals. Desert foxes at times prove destructive, especially to the kids. Where control measures are required, stockmen should secure assistance regarding methods and plans for organizing and conducting control campaigns from the Bureau of Biological Survey, as specialists from that bureau cooperate with State officials and stockmen's organizations in the more important parts of the range country and will gladly extend all possible service.

### DISEASES OF GOATS

The number of general diseases to which the goat is subject is small. However, there are instances when an infectious disease becomes established in a herd, in which the resulting losses are quite serious.

#### Parasitic Diseases

The parasites of goats have received relatively little attention in the United States, except those that occur also in sheep and cattle. This may be due partly to the lesser economic importance of goats and partly to the fact that when kept in rough country, as most of them are, they are less susceptible to parasites than are sheep and cattle kept on pastures. Sheep parasites have received much more attention. The available information in regard to sheep parasites is covered in Farmers' Bulletin 1330 (*9*) of the Department of Agriculture; in general that information is also applicable to goat parasites.

Goats are safer from parasites as a rule, in rough hilly country than in level country, in dry areas than in wet areas, in cold climates than in warm climates, and in winter than in summer in temperate climates. Many parasites are conveyed from goat to goat in the manure, and the danger from manure and its content of parasite eggs and larvæ is less when goats are feeding on relatively uncontaminated food such as shrubs and tall vegetation than when feeding on short grass, although it is possible for goats used as brush cleaners to become heavily infested with worms. Abundant pasture serves to scatter worm infection occurring in manure in such forms as worm eggs, and to safeguard the goats, whereas overstocking tends to con-

centrate infection and increase the danger from parasites. On the other hand, small bare inclosures can be kept clean, and this sort of sanitation is protective. Pasture rotation and flock movement is protective in removing animals from sources of infection. When none of the safeguards mentioned can be used, treatments to control parasites may be necessary. In general, diagnosis and treatment is the business of the veterinarian, and it is advisable to call in a competent veterinarian when disease is actually present. On the other hand, prevention is primarily the business of the stockman, and he should use such of the measures mentioned above as may be applicable and feasible.

Young animals are especially susceptible to parasites and the bad effects of parasites and should be given special care. They should be kept away from older animals, other than the mother, so far as possible, and given the best and safest pasture or range in order to prevent infection by contact with older animals carrying parasites without evident symptoms of parasitic disease. With increasing age they show an increasing immunity to parasites and the bad effects of parasitism. The bulk of the losses come in the first year of life, and this is the time to protect the livestock most carefully.

Parasitic diseases, unfortunately, are not spectacular, as are many of the bacterial diseases, and hence are often overlooked and neglected. Bacterial diseases run an acute course in many cases, the affected animals show fever and distress, and death losses occur within a comparatively short time. Parasitic diseases are insidious; they come on slowly, and by the time an affected animal dies it has become regarded as an unthrifty animal which "doesn't amount to much, anyway," in the opinion of the owner, and hence its death is regarded as no great loss. This is especially true of young animals which have not had time to give evidence of value before they become victims of parasites.

Parasitized animals usually show no fever but gradually lose condition and become unthrifty. In general, unthriftiness in animals is caused either by poor breeding, poor feeding, or parasites. If the first two causes can be eliminated, one should always think of parasites as probably responsible for the trouble and should take steps to confirm this diagnosis. Animals should be examined in a good light for evidence of such external parasites as lice or mange mites, and it is often advisable to kill one of the most unthrifty animals and make a careful examination of the digestive tract, lungs, and other organs for parasites, or, better, to have this done by a competent veterinarian. Unthrifty animals which have pale lining of the eyelids and mouth and have watery swellings under the jaws are likely to be victims of such bloodsucking worms as stomach worms and hookworms.

### EXTERNAL PARASITES

The external parasites are those which live on the outside of the body or in the skin and hair follicles, such as lice and mites, or which visit the exterior of the body from time to time to feed on the skin or blood, such as certain bloodsucking flies. They include lice, mange mites, ticks, and screw worms and other maggots.

Lice are widely distributed over the United States on goats and have been reported as being present in practically every herd in the Southwest. They attack the skin and cause itching and irritation, interfering with nutrition and the important business of eating and keeping in good condition. The mohair clip is diminished as a result of lowered vitality and of injury to the hair by rubbing and by the actual effects of the lice on the hair. Certain goat raisers in Texas have reported a loss of 20 per cent in the mohair clip from the effects of lice and have stated that often individual goats are so denuded of hair as to make clipping unprofitable.

Goats may contract scab from sheep, although the mites are said not to propagate on the goats and the scab tends to die out. Forms of scab peculiar to goats also occur in the United States, including forms of body scab, ear scab, and the deep-seated follicular scab. In some countries scab in goats may occur in epizootic form, and it has been reported as causing losses of 20 per cent of the herd by death. In outbreaks in this country some goats died of the disease, and others were seriously affected.

Ticks are most prevalent on goats in the South and may occur on the body or in the ears. They diminish the vitality of the animal and may cause a serious or fatal form of paralysis by attaching about the base of the skull.

Screw worms are a very serious pest of goats in the Southwest, but their attacks are infrequent elsewhere. They attack shear cuts or other wounds and may also attack the navel, mouth, ears, anus, vulva, or penis sheath, and the injuries may at times be serious or even fatal.

Biting (red) lice and sucking (blue) lice are best controlled by dipping in coal-tar creosote dips, cresol dips, arsenical dips, and 0.07 per cent nicotine dips with 2 per cent flowers of sulphur added. Biting lice may also be destroyed by the use of sodium fluoride in amounts of 1.3 ounces applied to each animal with a dust gun, but this must be kept away from sores or mucous surfaces; it is advisable to mix it with an equal amount of some inert powder such as talc. Superficial forms of scab may be cleaned up by two dippings at 10 to 14 day intervals in lime-sulphur or nicotine-and-sulphur dips, but the deeper varieties, such as sarcoptic scab, require four dippings at 6 to 10 day intervals, and follicular scab requires special treatment of each affected area, such as pressing out the diseased material from the hair follicles and the injection of a suitable substance to destroy the mites. Ticks on the body may be destroyed by arsenical dips and those in the ears by the injection of a mixture of 2 parts pine tar and 1 part cottonseed oil. Screw worms may be destroyed by injections of benzol followed by an application of pine-tar oil to repel the flies.

### INTERNAL PARASITES

Goats are frequently infested with internal parasites living in the digestive tract, lungs and other organs, tissues, and cavities. About 70 species of parasitic worms have been reported from goats, together with a number of internal parasites other than worms. Among the latter is the insect larva commonly called grub-in-the-head. This is one of the fly maggots which lives in the nostrils, frontal sinuses,

and other sinuses and causes the condition commonly referred to as "snotty nose."

About 15 species of tapeworms are reported from goats. These include such forms as the adult worms in the digestive tract and also the immature tapeworms that live in the liver, mesenteries, and other parts. The intestinal tapeworms are made up of small segments, sometimes called joints, and may be several feet long. They may cause digestive disturbances and unthriftiness. The immature tapeworms, or bladder worms, resemble a bladder full of fluid and containing a white body which is a tapeworm head, or sometimes many of these heads. The bladder worms are young stages of dog tapeworms, and dogs should either be kept free from tapeworms or kept away from goats.

About 14 species of flukes are known from goats. In the United States one of these flukes is the common sheep liver fluke, the cause of liver rot. It is most prevalent along the Gulf of Mexico and the Pacific coast, especially in wet, swampy areas. This fluke causes serious liver damage and gives rise to diarrhea, watery swellings under the jaws, emaciation, and sometimes death. Another fluke is the lung fluke, occurring in swine, dogs, and cats in this country, and found on one occasion in the goat, in Mississippi.

About 40 species of roundworms have been reported from goats, and these include such important forms as the stomach worm, hookworm, nodular worm, and lungworm. The stomach worm lives in the fourth stomach, the one to which the small intestines attach, and is a bloodsucker. It is especially dangerous to young animals, and when it is present in large numbers an infested flock falls off very markedly in condition, and the animals, especially the young ones, begin to die, often at the rate of one or several a day. Hookworms occur in the small intestine and cause somewhat similar troubles and losses. Nodular worms occur in the large intestine, and the young worms burrow in the lining of the intestine and give rise to nodules which may become filled with cheesy matter. Animals with bad cases of nodular disease may become emaciated, may have a severe diarrhea, and may succumb to the disease.

Lungworms occur in the air passages of the lungs and in the air cells and lung tissue. The larger species may be seen in the air passages, as threadlike worms; the more minute forms in the air cells are very small and hairlike. Infested animals usually have a husky cough, and the lungs show a bronchitis or pneumonia.

When stomach worms or intestinal worms are prevalent it is advisable to call in a competent veterinarian to treat the animals and give advice as to control measures. When the control measures outlined in the beginning of this discussion on parasites are inapplicable or fail to control these parasites, the routine use every two or three weeks of a 1 per cent copper-sulphate solution containing 1 per cent by weight of snuff or powdered tobacco has been found to give excellent results. Infestations with liver fluke have been found to yield to treatment with carbon tetrachloride at the rate of 1 cubic centimeter in capsule to each infested animal. Lungworms do not appear to be susceptible to treatment with any certainty, and the best control measure for sick animals is to move them to a safe area and nurse them along with nourishing feed until they recover.

The aggregate losses from parasites are very large. To prevent them the careful owner should adopt the following procedures whenever necessary: Do not overstock; avoid wet swampy areas; give young animals special care and attention and keep them away from older animals and infected areas; suspect all unthrifty animals of being cases of parasitism; clean out external parasites by dipping or other appropriate measures; keep dogs free from tapeworms or away from goats; and call in a competent veterinarian when goats are evidently sick or losing condition.

## Infectious Diseases

### ABORTION

The presence of the abortion bacillus, an injury, or the presence of some febrile disease may occasionally cause a pregnant doe to abort. This accident is very rare, however, and seldom shows a tendency to spread to other members of the herd. Before the abortion occurs there is often present a marked catarrh of the genital passages, with a discharge of mucous which sometimes contains blood. Should the abortion occur during the early weeks of pregnancy the fetus will probably be dead when expelled. Those born later are so weak and defective that they seldom reach full maturity.

### GOAT POX

In common with other domestic animals, goats may be affected with pox or variola. They sometimes contract pox from close association with sheep affected with sheep pox. The virus may be found in the contents of the eruptions. Infection follows direct contact. The disease spreads with great rapidity in a herd of goats but does not often spread over large sections of the country.

### LIP AND LEG ULCERATION

Lip and leg ulceration sometimes develops in a herd of goats, causing scabby sores or ulcers upon the lips, nose, legs, or other parts of the body. If neglected, a large portion of the herd may contract the disease, particularly during the breeding or the kidding seasons. The diseased animals should be separated from the others and given careful treatment. The ulcers should be cleaned and then should receive a generous application of some coal-tar dip or of creosol, in 3 per cent solution in either case. The scabs and sores usually disappear quickly after this treatment. The treated animals should not be returned to the healthy part of the herd until fully recovered.

### MALTA FEVER

A febrile disease of goats which, while not very serious in its effect upon the animals concerned, is often of the greatest importance in its ultimate actions, is known as Malta fever, undulant fever, or goat fever. The diseased animals give very little outward evidence of being affected as they continue to eat as well as usual and the

disease does not lessen the amount of milk secreted to any appreciable extent. The milk and urine from these animals, however, contain numerous bacteria, and those in the urine serve to spread the infection among healthy animals, while those in the milk frequently lead to the development of a painful and distressing disease in members of the human family if they drink the milk without pasteurization. In several instances laboratory workers have contracted the disease while making a study of material obtained from affected goats and have been unable to free themselves of it for years.

The symptoms in human beings are marked. Possibly the most noticeable is a series of attacks of fever with periods of normal temperatures between, each onset of fever being accompanied by severe headache and dull pain in the long bones and back. Diarrhea is often present.

Because of the serious effects of raw milk from affected goats upon human consumers, it becomes necessary that all milking herds that produce milk for food should be absolutely free from infection with Malta fever.

### TAKOSIS

There occasionally appears in goats that are shipped from southern latitudes to more northern localities, a malignant infection which proves very destructive, having been known to destroy as many as 85 per cent of the herd. Goats with this disease have a persistent diarrhea, which leads to progressive anemia and emaciation, together with troublesome pneumonia. Death from takosis may occur in from one to eight weeks. Treatment of an outbreak consists in separating the diseased animals from the rest of the herd and in providing sanitary surroundings and the best nourishing feed for the unaffected animals. Fortunately, takosis seldom remains troublesome after the goats have become acclimated and fully established in their permanent home.

## FINANCING MOHAIR GROWERS

Financing involves investment and risk. It is often possible for the mohair producers to share a portion of the investment burden by borrowing from a bank or other financial institution on notes, warehouse receipts, or bills of lading. The interest rates represent the cost of having this service performed.

The risk involved is of four types, which may be designated as (1) possible damages, (2) loss and deterioration, (3) price changes, and (4) inefficient management. The first type is the responsibility which goes with ownership and possession because of the injury or damage which may be done to or by the products owned. The second is the risk of physical deterioration, destruction of the products, or losses from theft. The third is the possibility of financial loss caused by a disappearing market or declining prices. The fourth type includes losses from poor management and such losses as accounts which can not be collected.

During the time when the goat raiser is producing mohair and preparing it for market, he usually furnishes the labor and funds

for the necessary investment and carries the attendant risks himself. However, by borrowing a part of the funds, the producer may shift part of the investment burden to others. The country merchant, the local dealer, or the banker who supplies the producer with funds on a lien basis assists in carrying the investment burden and assumes part of the risk. Occasionally the producer engages to sell his clip before it is shorn or sells on terms by which the buyer assumes the greater part of the investment and risk.

During the period in which mohair is in the regular channels of trade, the functions of financing and risk taking are more largely performed by special agencies. The investment can be covered by loans made on bills of lading and on warehouse receipts. All possible losses by deterioration, theft, and destruction can be minimized by insurance. The risk of loss because of disappearing markets or declining prices is ordinarily carried by successive owners between the time of production and consumption.

When credit is used, the interest collected indicates the cost of obtaining the use of the capital. In the same manner, the premium paid to an insurance company represents the cost of carrying the risk of loss or destruction. Those portions of the investment and risk which are not or can not be transferred, have a cost which can be measured as truly as those which can be shifted to the special agencies and professional risk takers. Compensation is due all persons who furnish capital or carry risks. These persons may be producers, middlemen, or consumers. The compensation received or expected may be the actual costs to the persons rendering the service, or it may be the cost which would ordinarily be involved.

Credit is borrowed capital which must be repaid with interest at some future time. Its use is justified only when it adds sufficiently to the wealth-producing power of the borrower not only to repay the loan but also to leave him a fair profit. There are two kinds of credit—personal credit and secured credit.

Personal credit is usually short-time credit and is used for buying machinery, equipment, work animals, feed, etc., in hiring labor, and in purchasing supplies necessary to the successful conduct of the farm enterprise. Much of this credit is obtained from the merchants and dealers who sell the goods to the producer on time, taking his personal note or in some cases simply granting him a definite amount of credit at the beginning of the year to be advanced as needed and charging interest on the full amount for the entire season. This form of credit forces the borrower to pay higher prices for his goods than he would if he could pay cash, and is generally wasteful. The grower who can not obtain sufficient credit usually buys supplies in small amounts as the need arises, and thus can not always purchase at the time of the year when supplies can be obtained at the least cost or when he has the best facilities for ordering, hauling, and storing them. These difficulties are overcome if the grower is in a position to arrange for personal loans directly from the banks rather than indirectly from the dealers and merchants who in turn rely upon the banks.

The second form of credit is secured credit. Usually the borrower secures the lender by giving him a mortgage or lien on some property which has a value greatly in excess of the amount of the loan.

This form of credit is usually used to purchase land, water rights, or buildings, to erect buildings and fences, to purchase livestock for productive purposes, or to provide for the orderly marketing of the clip.

The length of the credit period properly depends on the purpose for which the money is borrowed. Loans made for the purchase of real estate are seldom for less than five years, and usually a much longer period is required for repayment. On the other hand, loans for the purchase of feed are usually for not more than six months. Money borrowed to purchase goats for mohair production should run at least until after the mohair can be clipped and marketed, but if the money is invested in purebred breeding stock, the loan should logically run for several years. In any case, the loan should be for a period long enough for the creation of new wealth sufficient to repay the loan with interest.

Money lenders prefer to invest near home, where they can actually see the security offered and feel assured of the safety of their investment. As the distance from the investment increases, the feeling of risk becomes greater and the opportunity to verify the character of the security becomes less, and accordingly the money lender adds a certain amount to the interest rate as insurance to compensate him for assuming this extra risk. The rate of interest will vary in different localities also according to whether the opportunities for investment exceed the amount of capital available.

When personal credit has been used to meet the expenses of production of the mohair crop, the producers are in debt at shearing time and must either sell their mohair at once on a crowded market or obtain other advances with which to meet their maturing obligations. This can be done for the producers by a cooperative association that grades, warehouses, and insures the mohair, and offers the warehouse receipts as security. The cooperative can accept the drafts of the individual members and present them to an ordinary bank of deposit for discount. One who does not belong to a cooperative association, however, finds it much more difficult to obtain the necessary advances.

Another source of credit is found in the dealers and merchants. Purchases on the installment plan are so familiar it is not always realized that the dealer is really performing a credit function when he allows deferred payments. But the merchants give another kind of credit in allowing bills for supplies to run with no payments until after shearing time. For this service extra compensation is expected. Credit prices are much higher than cash prices, and merchants usually charge a high rate of interest on the account in order to cover possible losses through crop failures occasioned by heavy rains at shearing or at kidding time, extended dry seasons which burn up the range and dry up the water holes, heavy snows in winter which force large feed purchases, or from other causes. This form of credit, although much used and extremely useful, is very expensive.

Other common sources of credit are the commercial banks and trust companies. The banks, as a rule, are equipped primarily to handle loans to merchants and manufacturers, who have a rapid turnover and require large loans for a comparatively short time.

The funds of ordinary commercial banks consist largely of deposits which are subject to withdrawal by check at any time. They must, therefore, make most of their loans for short periods so that they can be quickly recalled if necessary. Most loans to farmers are made for not more than three to six months, with the understanding that they may be renewed if the bank is in a position to do so. Often the local banker is not sufficiently well acquainted with the farmer to be willing to loan money directly to him but prefers to loan it to a merchant or will discount the notes which the farmer has given to the merchant. In this way the risk is shifted from the bank to the merchant. Then, too, the seasonal character of the goat raisers' demands may be such that practically all of the mohair producers in a community require loans at the same time, and the local banks may not be able to carry the burden.

Loans by savings banks and trust companies differ from loans by commercial banks in that the former generally prefer long-time loans and farm mortgages are often favored. However, they are limited in the amount they can loan on mortgage security and the producer as a rule must look elsewhere for part of his credit requirements. Insurance companies, particularly life-insurance companies, make long-time loans on farm mortgages, and are an important source of farm credit.

There are several Government owned or Government supervised agencies to provide credit for the farmer. The Federal reserve banks assist in taking care of short-time farm loans. These banks can not discount paper which has more than 90 days to run, except loans made for "agricultural purposes" which may be discounted for a period not exceeding nine months. But most State banks are not affiliated with the Federal reserve bank of their district, and so can not benefit directly from this source of rediscount.

National agricultural-credit corporations may be formed by five or more persons, with the approval of the Comptroller of the Currency. They must have capital of at least $250,000. These corporations may advance money on notes, drafts, or bills of exchange drawn for agricultural purposes, having a maturity of not more than nine months and which are secured by warehouse receipts covering staple agricultural products including mohair or a first lien on livestock including goats being fattened for market. They can also make advances on chattel mortgages having a maturity of not more than three years and covering maturing or breeding herds. These corporations are limited in their interest rates only by the laws of the State in which they are located.

Another source of farm credit is the Federal intermediate credit banks. There are 12 Federal intermediate credit banks, each having a capital of $5,000,000 all of which has been subscribed by the Government. Federal intermediate credit banks are located as follows: Springfield, Mass.; Baltimore, Md.; Columbia, S. C.; Louisville, Ky.; New Orleans, La.; St. Louis, Mo.; St. Paul, Minn.; Omaha, Nebr.; Wichita, Kans.; Houston, Tex.; Berkeley, Calif.; and Spokane, Wash.

The Federal intermediate credit banks have the power to discount for or purchase from any national or State bank, trust company, agricultural credit corporation, incorporated livestock loan company,

savings institution, cooperative bank, cooperative credit or marketing association of agricultural producers, organized under the laws of any State or of the Government of the United States, any note, draft, bill of exchange, debenture, or other such obligation the proceeds of which have been advanced or used in the first instance for any agricultural purpose or for the raising, breeding, fattening, or marketing of livestock, except that no paper shall be purchased from or discounted for any corporation engaged in making loans for agricultural purposes or for the raising, breeding, fattening, or marketing of livestock, if the amount of such paper added to the aggregate liabilities of such corporation exceeds 10 times the paid-in and unimpaired capital and surplus of such corporation. Provided further, that no rediscounts will be accepted from any institution which has not a paid-up and unimpaired capital of at least $10,000.

The collateral securing such notes should be self-liquidating within the period for which the loans may be made. That is, in the natural course of production and marketing, the collateral should be salable at the end of the period, for an amount sufficient to discharge the debt.

Notes given by farmers to merchants for the purchase of supplies, machinery, fertilizer, etc., can not be rediscounted at the intermediate credit banks. The service in that case would be to the merchant and not to the farmer. However, a farmer's note given to a financial institution and the proceeds used for the purchase of farm supplies, machinery, fertilizer, etc., may be rediscounted at the intermediate credit bank.

Loans or discounts must have a maturity of not less than six months nor more than three years from the time they are made or discounted at a Federal intermediate credit bank. There is no rule as to the number of times a properly secured note may be renewed. Borrowing and discounting agencies have preferred loans and discounts having a maturity of not more than 12 months, with the understanding that proper renewals would be granted.

One purpose of the Federal farm loan act was to provide adequate credit to farmers on the basis of a long-time for repayment at an interest charge as low as rates in the investment markets would permit. The rate of interest charged to borrowers by all the Federal intermediate credit banks, is governed by the rate at which they can sell their bonds. That is, every bank is limited in its interest charge to not more than 1 per cent above the rate at which its last preceding issue of debentures was sold.

No organization may, without the approval of the Federal Farm Loan Board, discount with any Federal intermediate credit bank, any note or other obligation upon which the original borrower has been charged a rate of interest exceeding by more than 1½ per cent per year the discount rate at the time the loan was made. The board has approved the charge of a rate of interest upon livestock loans of not more than 2½ per cent in excess of the discount rate, where in the judgment of the officers of a Federal intermediate credit bank such a rate is warranted. In discounting livestock loans consideration is given to the integrity, experience, and financial condition of the borrower, as well as to the class, location, and value of the livestock reported by a competent inspector, and the ability of the borrower to provide ample range, feed, water, and protection.

The Federal intermediate credit banks can not make loans directly to individuals but can assist in financing sound cooperative associations, and these cooperatives in turn take care of the individual's needs, particularly for marketing credit. According to the Federal farm loan act (*25*), section 202 (*a*) subsection (3), the banks shall have the power

> to make loans or advances direct to any cooperative association organized under the laws of any State and composed of persons engaged in producing, or producing and marketing, staple agricultural products, or live stock, if the notes or other such obligations representing such loans are secured by warehouse receipts and/or shipping documents covering such products, and/or mortgages on livestock: *Provided*, That no such loan or advance shall exceed 75 per centum of the market value of the products covered by said warehouse receipts and/or shipping documents, or of the live stock covered by said mortgages.

Intermediate credit banks will accept the receipts of any warehouse that is licensed and bonded under the Federal warehouse act (*24*). In all other cases the warehousing laws and regulations of the State controlling the same must be submitted to the Federal Farm Loan Board for approval. However, warehouse receipts will be accepted only upon agricultural products which are nonperishable and readily marketable.

The amount of money to be loaned on warehouse receipts is determined at the time the application for a loan is made and depends largely on production and marketing conditions and on the strength of the particular marketing association. Under no circumstances, however, may the amount exceed 75 per cent of a fair market value of the commodity warehoused.

Organizations, whether cooperative or not, that are engaged in buying feed, fertilizer, or other agricultural commodities, and distributing these among their members, can not borrow directly from the intermediate credit banks, even though such commodities shall be warehoused and the warehouse receipts be offered as security. Farmers wishing credit for the purchase of agricultural products, livestock, machinery, or other equipment to aid in agriculture, can reach the Federal intermediate credit banks only through commercial banks, properly capitalized agricultural credit corporations, or livestock loan companies, all of which may have such paper rediscounted. However, the Federal intermediate credit banks will not rediscount individual members' notes for cooperative marketing associations which have no capital stock.

The long-time credit needs of the farmer are served by the Federal land banks and the joint-stock land banks. These banks can not make loans for less than 5 years nor more than 40 years, and it is further provided that these loans shall be paid back in equal annual or semiannual installments. This method of repayment is called amortization. The joint-stock land banks supplement the work of the Federal land banks. It is not necessary for a borrower from a joint-stock land bank to become a member of a national farm-loan association.

Loans are made by both groups of banks for the following purposes: To purchase land for agricultural purposes; to purchase equipment, fertilizer, and livestock needed; and to provide for buildings and improvements. However, no bank can loan a sum greater

than 50 per cent of the appraised value of the land and 20 per cent of the permanent, insured value of the improvements on the land.

To obtain a loan from a Federal land bank, it is usually necessary to join a national farm-loan association, if one exists in the community, and to subscribe to stock in such association in an amount equal to 5 per cent of the loan desired. The law provides that 10 or more persons, owners, or prospective owners of farm land, may form a national farm-loan association. This association must subscribe to an amount of stock in the Federal land bank equal to 5 per cent of every loan applied for. That is, if a farmer desires to borrow $10,000, the loan association must subscribe to $500 of the capital stock of the Federal land bank. When the application for the loan has been approved, the credit is extended in return for a mortgage. The interest to be charged on the loan is not fixed by law, but it can not exceed 6 per cent nor shall it be more than 1 per cent above the interest rate on the bonds last sold by the bank.

## MARKETING ANGORA GOATS AND THEIR PRODUCTS

### MARKETING GOATS FOR BREEDING PURPOSES

The marketing of Angora goats for breeding purposes presents a problem that is entirely different from that involved in marketing goats for mohair production or for meat. Three methods of marketing have proved satisfactory in the past. First, direct sale at private treaty. Exhibiting goats at county, or State fairs is an excellent way to attract attention to the merits of one's goats. Prospective purchasers can compare them with the goats of the other exhibitors. If a man who has not yet acquired a reputation as a breeder can secure one of the prizes for his goats, he will have valuable advertising and a good sales argument and may be able to dispose of his entire surplus of goats to local purchasers. A goat breeder who fails to take any prizes at least has an opportunity to see wherein his goats are inferior to the winners, and can proceed more intelligently toward the improvement of his animals. In any event, an exhibitor will meet other men who are breeders or who are interested in acquiring animals for breeding purposes, and these contacts may be valuable to him in creating a market for the goats.

A second method is the auction sale. This method is excellent if a large number of dealers take part, but considerable money is required to advertise such a sale properly, and if only a few breeders participate, the expense may prove prohibitive. However, sales by auction provide an effective means of quickly disposing of animals for cash and since the animals are subject to inspection by the buyer, the possibility of disputes after the sale is reduced to the minimum.

A third method of sale is through the mails. This method requires considerable advertising in the trade papers. During certain seasons of the year it may be advisable to have advertisements appear in every issue of a selected paper, for the breeder must keep his name and the good qualities of his goats constantly before potential buyers in order to secure satisfactory results. Advertisements should be brief and should be changed often enough to cause readers to realize that the seller is alert and has something worth while to offer. When a sale has been made, every effort should be made to give the buyer

exactly what he ordered, for a satisfied customer is likely to reorder when he needs more goats and will probably recommend the breeder to other goat raisers. On the other hand, if a dealer does not fill orders satisfactorily it may come to the attention of other stockmen and create a prejudice that will be difficult for the dealer to overcome.

If bucks sold for breeding purposes are to be transported a long distance, they should be so shipped as to arrive several days prior to the breeding season, in order to give them an opportunity to recover from the effects of the journey. It would be well for the seller to advise the purchaser that goats need this period of rest in order to avoid unsatisfactory results in breeding.

Goats, for breeding purposes, should be shipped in crates that are just large enough to allow the animal to stand erect comfortably and only slightly wider than the width of the body. If too much room is allowed, the animal is more liable to injury in transit. Sufficient feed for the entire journey should be attached to the outside of the crate. Goats sent by express arrive at their destination sooner and probably in much better condition than goats sent by freight. The cost of shipping goats by express is usually not much greater than the cost of shipping them by freight.

### MARKETING GOATS FOR CHEVON

One of the most important problems of the mohair producers, is the disposal of the surplus goats for meat. This may be accomplished in several ways. In the first place, the goat raisers may kill and dress their own goats for local consumption. Goat raisers are fortunate if they are located in sections where chevon, the meat of the goat, is appreciated so that there is a local demand for the surplus animals. Many growers lack the equipment necessary for home slaughter and dressing, except perhaps for their own consumption, and since the demand for chevon, on the ranges, is seldom equal to the supply, it is necessary to seek outside markets.

If the goat raisers are located near a small town, the local butchers can usually be depended upon to take some of the stock, but here too, the demand is very limited, for a prejudice exists in many localities probably due to the harmful, short-sighted practice of selling aged goats for slaughter.

Kids and young does yield a much more desirable meat than the older goats. It will therefore pay the growers to sell their cull goats while still kids and to sell all but the best wethers either as kids or as yearlings. Good, fat chevon is wholesome and appetizing, and therefore it is advisable to market the goats sold for meat in as fat a condition as possible.

The easiest way to dispose of goats for meat, is to sell the goats to local buyers who operate in the territory around a local shipping station, canvass the farms and ranches in order to buy various lots of animals, and assemble them for shipment in carload lots to the central markets. Local buyers do not act as agents of the producers, but buy outright and usually pay immediately for the goats purchased.

If the grower does not care to sell to the local buyer, he can ship the goats to one of the larger livestock markets. Kansas City has been the leading goat market in this country for many years. If the

goats are consigned to one of these larger markets, it is advisable to notify the selling agency several days before making the shipment, to give the agency an opportunity to warn the shipper if there is danger of the market becoming glutted.

The shipper must order a stock car and drive the goats to the local shipping station, where loading pens and chutes are maintained; the goats are then loaded into stock cars which may be double-decked for sheep and goats.

Whenever possible, goats should be shipped in carload lots to arrive at their destination without unnecessary delays for transfer of stock from one car to another. It is cheaper to ship in carload quantities. When one or more carloads of goats are shipped at once over a long distance, an attendant should accompany them. The railroad company will allow him free transportation on the going trip but he must pay his return fare. Some companies allow return fare also if two or more cars are shipped at once. If the journey is only a day or a day and one-half, it is usually not necessary to send an attendant.

After the stock is loaded, the local freight trains haul the cars to the main lines, where they are reassembled into special livestock trains and run on fast schedules to the central markets. These trains are usually, but not always, timed to arrive at the stockyards early in the morning.

When the train arrives at the central market, the goats are unloaded and yarded by representatives of the stockyard company or of the selling agency. When such shipments are received at markets where public stockyard inspection is maintained, they are examined for disease by inspectors of the United States Bureau of Animal Industry. Pens and all other necessary equipment for feeding, watering, and sheltering the goats are provided at such yards. Dipping equipment is available for goats which are to be returned to the country.

Buyers visit the pens and make offers for the goats. If the offer is satisfactory, the animals are driven at once to the scale house, where they are weighed, and the seller is presented with a scale ticket showing the number of animals weighed, their total weight, and the names of the selling agency and the buyer. Final settlement is made on the basis of the weight shown on this ticket and not on the weight of the goats when shipped. There is usually a considerable shrinkage in weight during the trip. As soon as the stock leaves the scale house it becomes the property of the buyer and is usually driven directly to his pens.

The selling agency usually makes up the accounts on the afternoon of the day the sales are made. The bill is presented to the buyer, who indorses it and returns it with an order or a check attached. The selling agency immediately returns to the shipper a statement of the weight and price, together with a list of the charges, such as freight, yardage, feeding costs, bedding, dipping fees, commission, or any other charges that may have to be deducted from the selling price. The balance is paid to the shipper by check or draft.

The railroads have established minimum quantities to which the carload rates apply. If the farmer does not have enough goats to fill a car himself, it will be to his advantage to combine with his

neighbors in a cooperative shipment, in order to take advantage of these lower rates. A farmer may wish to cooperate with his neighbors and yet may not know how to proceed to bring together a cooperative shipment.

### COOPERATIVE SHIPPING

The procedure for forming a cooperative-shipping association is not complex. Some progressive person has to create an interest in such a move, and then all of the goat raisers in the community, who are interested in shipping goats, are called together for the purpose of organizing, adopting rules, and electing a manager. Unless a capable manager is chosen, there is little likelihood of success.

The manager should interview the members in order to find out the number of animals they are going to ship, and the days on which it will be convenient for them to ship. As soon as enough goats have been promised to fill a car, the manager should order a stock car, notify the shippers, specifying the shipping date, and be on hand to receive the goats when they arrive at the station. Each lot of goats to be loaded should receive a special mark so that when they are finally sold, each shipper will receive payment for his own goats. The animals should then be weighed and a receipt given to the shipper, showing the number of goats shipped, their total weight, and the special identification mark.

The manager must supervise the loading of the car and see that proper bedding is supplied. He should not permit the use of cinders, rock dust, or similar materials. He should examine the car to see that all protruding nails are removed and that all holes in the floors are securely patched to prevent crippling of the goats. It is his duty to see that the car is not overloaded, as this may increase the losses from crippling, trampling, and suffocation.

The manager should send to the selling agency a list of all the lots shipped, together with the owners' names and the number of goats in each lot. A copy of this list should be kept to prevent disputes later. When the goats are sold, the selling agency returns a statement of the weight and sale price of each lot, and the manager settles with the shippers on the basis of this statement.

Little money is required to finance a cooperative shipping association, as the members will wait for their money until after the goats are sold at the central market. Usually the entire transaction can be completed in a week's time and then the producers can receive their money.

### FEDERAL MEAT INSPECTION SERVICE

The Federal meat inspection law (*23*) approved March 4, 1907, and the regulations of the Secretary of Agriculture governing the inspection of animals and their meat products, include goats and their meat products within their scope along with cattle, sheep, and swine. The benefits of Federal meat inspection extended by Congress to consumers of chevon are considerable and are reflected to the goat raiser by extending the market for his offerings of goats for slaughter for meat purposes.

This meat inspection service is administered through the United States Bureau of Animal Industry. Its purpose is to eliminate

meat which is diseased or is otherwise unfit for human consumption from the general food supply; to require that the preparation of the meats and products passed for consumption is cleanly; to guard against the use of harmful dyes, preservatives, chemicals, or other deleterious substances; and to prevent the use of false or misleading labels on the containers.

All of the slaughtering, packing, rendering, and meat-preparing establishments which sell or ship their products in whole or in part in interstate or in foreign commerce, are subject to Federal meat inspection. However, those concerns whose products are not sold or shipped outside the confines of the State in which their plants are located are not subject under compulsion to this Federal inspection.

If the proprietor of a plant desires Federal inspection, he must file an application with the Bureau of Animal Industry and submit triplicate copies of plans and specifications of his plant. Before inspection is granted, a qualified representative of the bureau is assigned to make a detailed inspection of the plant, and to decide what facilities must be provided to enable a ready and proper conduct of the inspection service. Strict cleanliness in regard to the rooms and equipment and in respect to the conduct of operations and the handling of the products is required, and proper facilities for the inspection must be provided.

Each establishment to which inspection is granted is given an official number, and this number with the words "U. S. inspected and passed" or an authorized abbreviation thereof must be placed on meat and products, or the containers, to show that they have been inspected and passed at that establishment under the Federal meat-inspection regulations. As long as the mark of inspection remains intact, the number will identify the product wherever it may be found.

Under the Federal system of inspection, not less than two examinations are made of each animal slaughtered in official establishments. The first is the antemortem inspection or examination of the live animal. This is usually performed in the pens or alleys of the establishments, although at some of the large livestock marketing centers it has been found convenient to conduct the examination in the public stockyards. All animals are carefully observed for any disease or abnormal condition which may cause condemnation in whole or in part. All animals which on antemortem inspection do not plainly show, but are suspected of being affected with, any disease or condition that may cause condemnation in whole or in part are marked "U. S. Suspect" or with other distinctive mark or marks to indicate that they are suspects. These animals are kept apart and slaughtered separately from those which passed the antemortem examination.

Animals which on antemortem inspection plainly show any disease or condition which would cause condemnation of their carcasses on post-mortem inspection are condemned and a metal tag showing a serial number and the words "U. S. Condemned" is affixed to an ear of all such animals. They may not be taken into the slaughter room but under the supervision of an inspector they must be destroyed to render them unfit for food. Animals which are found dead or in a dying condition on the premises of the establishments are condemned and disposed of in the same manner.

The postmortem inspection includes a careful examination of the carcass and all its parts at the time of slaughter. The identity of the carcass and each of its severed parts and viscera is carefully maintained until the inspection is completed, so that if there is a diseased condition in any organ or part all of the other parts may be brought together for additional and final veterinary examination. Facilities for maintaining such identity are provided in the slaughter department, and every inspector is supplied with serially numbered "U. S. Retained" tags, which he affixes to the retained carcass and to the severed parts by means of which they may be identified for later inspection.

In meat inspection, tuberculosis is encountered far more frequently than any other disease, and great care is exercised to detect its presence in even the slightest degree. This disease, however, is seldom found in goats, and during the fiscal year ended June 30, 1928, not a single case of tuberculosis among goats was found by the Federal meat inspection service.

All carcasses found to be free from disease or any doubtful condition are marked "U. S. Inspected and Passed," while those in which any diseased or doubtful condition is found are retained on the regular inspection and sent to the final inspection place; thereby an expert, searching examination is made to determine the final disposition. Only veterinary inspectors who have become skilled through training and experience in the work are detailed to make these examinations and determine the final dispositions.

To further insure the wholesomeness of inspected meat, the Federal meat inspection service maintains laboratories at central points throughout the country where chemical and bacteriological tests are made of samples of meats and products handled and prepared in official establishments or offered for importation into the United States. Examinations are made for forbidden preservatives and adulterants, and the curing agents, condiments, ingredients, water, and ice are tested for purity.

The Federal system is definitely composed of five coordinating inspections, namely: Sanitation, or the inspection of the premises, the equipment and all the operations in order to maintain clean and sanitary conditions; the ante-mortem inspection, or the examination of the live animals; the post-mortem inspection, or carcass inspection at time of slaughter; the products inspection, or inspection of processes in preparing and handling meat and meat-food products and requiring correct labeling of finished products: and the laboratory inspection or chemical and bacteriological tests of meat foods and all substances used in the preparation of meat and products at inspected establishments.

More than 75,000,000 animals were inspected in 829 establishments operated under Federal meat inspection during the year ended June 30, 1928, and nearly 9,000,000,000 pounds of meat and meat-food products were prepared and processed under Government supervision during the same period.

When the examinations have been completed and the dispositions determined, there remain two acts the performance of which completes the post-mortem examination. They are to mark each carcass to show plainly the disposition made of it, and to see that all carcasses

and parts which are condemned are disposed of as required by the meat-inspection regulations to prevent their sale or use as food. Every condemned carcass, part of carcass, meat, or product, is plainly marked to show that it is condemned; and any condemned parts or products too small or which are of such a nature that they can not be so marked, are placed in appropriately marked containers. All condemned articles remain in the custody of an inspector from the time they are condemned until they are properly destroyed in the presence of an inspector who renders a report of the transaction.

Condemned carcasses and parts are converted into grease and fertilizer by rendering them in a steam-pressure tank, or other rendering equipment, except that at a small number of establishments which do not have facilities for rendering inedible material, the condemned products are denatured by the addition of crude carbolic acid, or other prescribed denaturing agent, or they may be destroyed by incineration.

After the post-mortem examination has been completed, all products which have been passed as sound, wholesome, and fit for food are subjected to repeated reinspections as long as they remain in inspected establishments. All processes such as curing, canning, rendering, refining, and smoking are closely supervised as required by the regulations, and all meats or products which have become sour, tainted, rancid or otherwise unfit for food are condemned and destroyed. No meat is admitted into an inspected establishment which can not be identified by marks of inspection as having been "U. S. Inspected and Passed."

During the 10-year period which ended June 30, 1928, a total of 413,300 goats were slaughtered under Federal inspection. Of this number only 1,243 were condemned on post-mortem examination. The chief causes of condemnation were emaciation, pneumonia, pleurisy, caseous lymphadenitis, septicemia, and similar conditions.

The mark of Federal meat inspection placed on goat carcasses, parts, or meat-food products at inspected establishments, entitles such meat or product, if sound and fit for food at the time of shipment, to be distributed in interstate or foreign commerce. For foreign shipment, the Department of Agriculture will, upon application from the exporter, issue a certificate of inspection for each consignment of chevon or other products.

## MARKETING MOHAIR

The methods of marketing mohair vary in different parts of the country and also in respect to the quantity of mohair that any grower may have to market. Among the more important agencies involved in getting mohair from the producer to the consumer are the country buyer, the country assembler, the central market dealer, the commission merchant, the broker, and the manufacturer.

In the farm States, where the production per farm is usually relatively small in comparison with the production in the range States, the country buyers and the country assemblers are among the most important agencies. They buy up the small lots and either concentrate them in their own warehouses or ship them to some central market. The central-market dealers also send agents into these small producing communities and concentration points, they buy

such mohair as may be available and forward it to the large centers, where it is graded and stored on the basis of mill requirements, and is finally sold to the manufacturers.

Another form of marketing is to consign the mohair to some commission man or broker in the central market or concentration point. The commission man sells the mohair for his client and, after deducting his commission and any advances which he may have made such as freight or handling charges, etc., he sends the grower a check for the balance due.

The small producers in the farm States often consign their mohair to a warehouse for storage and sale. In the range country, where production is relatively great, the growers often bring their mohair to these warehouses and either sell it outright for cash or obtain advances of a certain percentage of the market price, until such time as the mohair is sold to the mills.

When the mohair is received at the warehouse it is separated into two piles, kid hair and grown hair. When a large quantity has been accumulated, buyers, who may represent either brokers or mills, visit the warehouses and inspect the mohair by taking samples from the various bags. On a certain appointed day bids are received for different lots, and usually the highest bidder gets the lot. Sometimes the lots are withdrawn if the prices bid are considered too low. If a sufficiently large quantity of mohair is concentrated at the warehouse, it is usually graded and sold according to grade.

Recently the cooperative idea has been applied to mohair marketing, but because of the small quantity produced in many of the States it may be advisable to cooperate with the wool associations which have already been formed in those States. One of the largest wool cooperative associations on the Pacific coast is at present handling mohair for its members and is equipped to sort, grade, store, and sell it efficiently. Wherever these associations exist locally, and have already made satisfactory financial connections, it would be well to work with them rather than to attempt to start a new organization unless a sufficiently large quantity of mohair to insure the success of an independent association is certain.

### CONCENTRATING THE MOHAIR CLIP

The principal purpose in concentrating the mohair clips, is either to assemble a sufficiently large quantity of mohair in one place to attract the attention of buyers, or to take advantage of the lower freight rates allowed for shipment in carload lots to one of the central markets. If a large quantity of mohair is concentrated in one place, it can be sold directly to representatives of the large dealers or manufacturers at auction, public sale, or private sale, or it may even be sold through bids received by mail or telegraph. In any case, the accumulation of large stocks at one point makes it easier for the buyers to secure the kind of mohair desired.

Furthermore, if the clip is concentrated, competent graders can be secured. It is much to the advantage of the producers to have the mohair graded and sold on its merits, thus rewarding the producer of high-quality fleeces and providing an incentive to the other growers to improve their clips. It is not practicable to hire a grader to handle a small quantity of mohair because of the expense involved

and because competent graders are seldom available in the small communities.

If the producers do not have enough mohair in their locality to attract buyers, it is often advisable to combine the clips of several producers in order to ship cooperatively on consignment to some dealer, to some central pool, or to a wool warehouse which receives and stores mohair. By pooling the clips, growers can take advantage of the lower rates allowed on car-lot shipments.

The procedure for forming and operating a mohair pool is briefly as follows: Those interested hold a meeting and determine whether they will have enough mohair to conduct a local sale or whether they should ship their mohair to some concentration point where there will be enough mohair to conduct a sale. Officers are then elected whose duties are to canvass the members and prospective members for mohair; to set a date for the delivery of the mohair; to catalogue the various lots received; to decide whether it would be feasible to have the mohair graded and if so to see that it is graded; to set a date for the sale; to advertise the sale and see that prospective buyers are notified; to conduct the sale; to receive payments; and to return the proceeds to the growers.

### WAREHOUSING

Storage is the holding of a commodity from the time of its production until the time when it is needed for consumption, and preserving it as nearly as possible in the same condition in which it was received. This is a necessary service to the mohair industry because the manufacturing demand is spread over the year, whereas the shearing takes place within a relatively short period. If the growers have no storage facilities economically available to absorb this surplus supply, they have to dispose of their clips immediately and are therefore compelled to accept low prices, inasmuch as the sale of abnormally large stocks at one time usually depresses the market price. Storage overcomes this maladjustment between the time of shearing and the time of consumption, permits the more orderly marketing of the clip, and has a tendency to make price fluctuations less violent.

Mohair may be stored on the farms, in private warehouses, or in public warehouses which may or may not be licensed and inspected by the State or the Federal Government. As a rule, mohair is not stored on the farm because proper facilities are not available to protect it from theft and from loss or destruction occasioned by fire, water, vermin, or rodents. Goods so stored are not desirable security for loans at most banks, and many growers can not afford to store their mohair without obtaining loans.

The chief difference between private and public warehouses lies in the fact that the private warehouses are not subject to Government supervision, whereas the public storages are subject to regulation by the various States, and the federally licensed warehouses are subject to inspection and regulation by the Federal Government.

There are certain definite requirements to be met before the Federal Government will issue a license to a warehouse: (1) The warehouse must be suitable to protect the mohair from the weather, and

from fire, vermin, rodents, etc.; (2) it should provide all facilities necessary for the proper care and handling of the mohair; (3) the warehouseman must furnish a bond, varying in amount according to the capacity of the warehouses; (4) he must understand the proper care and handling of mohair; (5) he must be able to weigh and grade correctly; and (6) his moral and financial reputation must be such as to commend the confidence of the owners of the mohair and the banks which loan money on the warehouse receipts.

When mohair is admitted to the warehouse, a receipt is issued to the depositor. This receipt may be either negotiable or nonnegotiable. If it states that the stored mohair will be delivered to the bearer, or to a specified person or his order, it is negotiable. On the other hand, a receipt which calls for delivery only to a specified person, is not negotiable. The former type of receipt is widely acceptable as a basis of loans by bankers, especially those receipts which are issued by a warehouseman who is operating under a Federal license. These Federal warehouse receipts contain the following information: (1) The location of the warehouse; (2) date when receipt was issued; (3) a number which is one of a series; (4) to whom the mohair will be delivered, whether to the bearer or to a specified person or to his order; (5) warehouseman's license number; (6) description of mohair, showing quantity, package and grade, also a statement showing on what basis or under what standards the grade was determined; (7) ownership of mohair, and statement as to extent of warehouseman's ownership, if any; (8) extent of advances made and liability incurred, for which the warehouseman claims a lien; (9) statement that receipt is issued under authority of the United States warehouse act and subject to terms of regulations under the law; and (10) signature of warehouseman or his agent.

Storing entails expense, regardless of the points at which it occurs or by whom the function is performed. If the farmer furnishes storage on the farm he expects that the price received at the time of sale will be at least equal to the market price at the time of production plus the cost of the storage. If the storage is furnished by a dealer, he expects to sell at a sufficiently increased price to allow compensation for rendering the service. The manufacturer who buys and stores mohair at the time of the spring or fall shearing for use later, reasonably expects that the difference between the price at which he bought and the price at which he would have to buy the mohair when he needed it for manufacturing will allow a margin sufficient to cover the cost of storing and carrying charges.

### MARKETING CENTERS AND TERMS OF SALE FOR MOHAIR

Market centers are essential for successful mohair sales. Centralization points should have a suitable warehouse for storing and handling the clips. The warehouse should be located on or near the main railroads or terminals, to insure prompt services for receiving and shipping the mohair, and to be readily accessible to the buyers who wish to examine the mohair.

The principal market centers of the United States are New York, Boston, Chicago, and Philadelphia. The mohair growers also have well-located centralization points and market centers in the West.

The mohair grown in Arizona, California, Oregon, and Washington is mostly centralized in San Francisco or in Portland, where it is graded and shipped directly to the manufacturers. Texas, which produces the larger part of the mohair clip in this country, has several local market points. The principal markets are located at San Angelo, Del Rio, Kerrville, and Uvalde, Tex. These towns have good railroad accommodations and are well equipped to handle large volumes of mohair.

Growers either ship the mohair or convey it in their own trucks to the warehouses located in these centralization points. Some growers leave the mohair to be sold at auction which is held on certain dates, when the accumulation warrants; other growers accept a cash advance from the warehouse company, allowing the company to handle the clip and accepting any price on which the company may decide. Often the grower needs the money and prefers to accept a cash offer rather than wait for a speculative market.

The warehouse conducts an orderly system of marketing. When the mohair accumulations are about completed, buyers are invited to the warehouse to examine the mohair, which is still in the original bags. The buyers are allowed to select several bags which will be opened for their inspection. When a fair representation of the lot has been examined by the interested buyers, a date is set for an auction sale of the entire lot. On the sale day, buyers submit their bids, and the mohair is usually sold to the highest bidder, but lots may be withdrawn and bids rejected if the offers are not satisfactory.

Mohair is usually sold on samples inspected, and the buyer must deposit a sight draft previous to the shipment. In some instances mohair may be bought on terms. Many of the large mohair buyers in the East buy on the following basis: Terms of 10 days are usually discounted at 1 per cent; terms of 60 days are net; terms of 90 days are usually charged interest after 60 days. The 60 and 90 day terms are often necessary on account of the time required to manufacture the goods before the manufacturer can obtain any returns.

Better results are obtained at the eastern market centers. Graders or classifiers are employed to classify the different grades in various piles or lots so that the manufacturers may procure any desired quality in large or small quantities, to suit their requirements. The large accumulations of mohair in the eastern warehouses are attractive to the manufacturers who find it economical to secure their requirements for short or quick orders from the eastern warehouses. Only a small quantity of mohair is graded or classified at the local centralization points.

The Pacific coast has a warehouse which classifies mohair according to the tentative grades of the United States. Here mohair producers may actually see their mohair graded before it is shipped to the mills. In this way they obtain valuable information as to the most desirable kind of mohair to produce.

### MARKETING GOATSKINS

Goatskins are held in high esteem by leather manufacturers as evidenced by the great number of skins imported annually into the United States. In 1926 approximately 68,000,000 pounds of dry-salted goatskins and 16,000,000 pounds of wet-salted goatskins were

imported. Only a small percentage of these were Angoras. Goatskins are usually chrome tanned and manufactured into dull, glazed, patent, or enameled kid for gloves, shoe stock, bags, pocketbooks, and furniture leather. Some skins are vegetable tanned and used for bookbinding or for fancy leathers.

The Angora goatskins differ from all of the other goatskins in that the grain is harder and more scalelike, and roughs up more readily when the leather is worked. Consequently, the value for leather is much less. After long experience in the production of leather from Angora goatskins, the tanners have found them adaptable chiefly for the cheaper grades of glove leathers.

### Imports

An inquiry addressed to the tanners of goatskins in the United States revealed the fact that almost the entire import of Angora skins comes from the Union of South Africa, with only occasional small purchases from Asia Minor. There is also a fair consumption of domestic Angoras and crossbred Angoras, which come chiefly from the Southwestern States, and amount to about 175,000 skins annually. Crossbreds in this country are usually white, whereas the South African crossbreds usually show a heavy percentage of dark-haired skins. Foreign purebred skins are about the same as the domestic but run lighter in weight and smaller in size. Little information is available as to the type of leather produced from the foreign crossbreds, but it is slightly firmer than that from north China goatskins.

### Leather from Goatskins

The leather made from the domestic Angora is of a large, loose-grained character, and when finished contains a white greasy spew which comes from the natural grease in the skins and which it is almost impossible to eliminate during the process of tanning. Angora skins are of a very heavy substance. Only the cheaper grades of leather are produced from these skins, the market for which is very limited. Leather from the domestic crossbreds, however, is of much finer, firmer grain, has less of the spew from the natural grease, and is lighter in weight, producing a medium grade of leather.

### Value of Skins

The value of a goatskin depends to a considerable extent upon the skill with which it was removed from the animal. Other things being equal, the better flayed skin will bring a better price from the tanner. The best skins for tanning leather are those obtained from the packers. These skins are taken off in large slaughtering houses where the workers are specialists in the work of removing and preparing hides and skins. The resultant product contains few imperfections, is uniformly cured, and is free from salt stains or from excessive salt or pickle. These skins produce the best grades of leather because of their careful and efficient handling.

Goatskins which originate in remote sections, where they are produced in small lots and are taken off by ranchmen, farmers, or local butchers who are inexperienced in such work, are not valued so highly by the tanners.

### Preparation of Skins for Market

The most serious defects in the take-off of these domestic goatskins are the failure to remove all of the flesh from the skins, cuts received in the slaughtering of the animal or in the removal of the skin, irregular pattern or trim, improper or careless curing, and the lack of uniform curing practices.

The skins may be sun dried, dry salted, or wet salted. Better results are obtained from wet-salted skins, because the nearer the skin is to its original state when it reaches the tanner the better the leather is likely to be. Furthermore, sun drying may leave a mark on the finished leather, for when the stiff, hard skins are packed they often crack where folded. Another objection to sun drying is the fact that the layers of the skin sometimes separate because the raw skin has been exposed to so great a heat that the exterior became very dry and hard before all the moisture had left the interior fibers, and putrefaction has resulted from the imprisoned moisture.

Flint-dried and dry-salted skins have been kept two or three years when properly preserved. As a rule, however, the fresher the skin the more desirable it will be for leather purposes and the greater the likelihood of obtaining satisfactory tanning results.

After the skin has been removed from the goat it should be thoroughly cleansed of all dirt and blood, the small particles of flesh adhering to the skin should be carefully cut or scraped away, and the uneven edges carefully trimmed.

To salt the skin properly, a clean, cool place, not in the direct sunlight, is selected. A little salt is sprinkled lightly over the hide which is placed with the hair side down, with all folds or creases carefully smoothed. Fresh clean salt is then sprinkled over the flesh side as evenly as possible, and is rubbed into the cut edges and into the head, neck, shanks, wrinkles, and thicker portions of the skin. About 1 pound of salt is used for each pound of hide.

If several skins are to be salted at one time, they may be placed one on top of another, but care should be exercised to avoid dragging one skin on the other as this is likely to disturb the salt and cause uneven curing. Provision is made for the salt liquor to drain away; otherwise the bottom skins will be damaged.

In hot, dry sections the skins are sometimes hung on a pole or rack, after curing, with the flesh side out, where they are exposed to a current of dry air. This eliminates the excess moisture in the skins and thus permits a saving in the labor of handling and the cost of transportation. These skins must be protected from the rain and from the direct rays of the sun and should be left until they become dry, firm, and somewhat stiff. Then they should be resalted lightly on the flesh side before they are stored or shipped.

If the ranchmen would exercise greater care in the removal of the skins, adopt uniform curing practices, and pool their production so that the skins could be graded for sale in large lots, they would be able to attract the attention of the eastern tanners, who require a fairly constant supply of skins with uniform characteristics.

## INTERNATIONAL TRADE IN ANGORA GOATS AND MOHAIR

Turkey and the Union of South Africa are the principal exporters of mohair. Before the World War there were about 3,000,000 An-

gora goats in Turkey, but practically half of this number disappeared during the war. Some of the goats died from disease or from the severe climatic conditions and many were killed to supply food for the armies. Further losses occurred during the war between Turkey and Greece from 1919 to 1922, because many of the major engagements of the war occurred in the finest mohair producing districts of Turkey. Latest reports, however, indicate that the number of Angora goats in Turkey in 1927 was over 3,000,000. This shows a remarkable recovery from the losses in the recent wars. According to figures supplied by leading exporters, the present clip in Turkey amounts to about 30,000 bales weighing from 168 to 182 pounds each. Practically all of this mohair enters into international trade. (See Table 9.)

TABLE 9.—*Mohair production in the Union of South Africa and in Turkey, in stated years*[1]

| Year | Union of South Africa | Turkey | Year | Union of South Africa | Turkey |
|---|---|---|---|---|---|
| | *1,000 pounds* | *1,000 pounds* | | *1,000 pounds* | *1,000 pounds* |
| 1839 | ---------- | 1,247 | 1900 | 11,990 | 12,000 |
| 1857 | 1 | 2,900 | 1901 | 12,000 | 12,500 |
| 1867 | 51 | 4,800 | 1902 | 13,500 | 12,700 |
| 1875 | 1,200 | 5,321 | 1903 | 15,300 | 12,800 |
| 1876 | 1,900 | 4,420 | 1904 | 16,800 | 12,600 |
| 1877 | 2,000 | 5,984 | 1905 | 17,000 | 12,500 |
| 1878 | 2,500 | 4,641 | 1906 | 16,500 | 12,500 |
| 1879 | 3,000 | 5,831 | 1907 | 18,600 | 12,400 |
| 1880 | 2,800 | 8,250 | 1908 | 18,200 | 12,500 |
| 1881 | 3,000 | 4,200 | 1909 | 19,650 | 12,200 |
| 1882 | 3,600 | 9,060 | 1910 | 17,800 | 12,600 |
| 1883 | 5,200 | 7,260 | 1911 | 21,000 | 12,600 |
| 1884 | 6,700 | 9,000 | 1912 | 23,400 | 12,400 |
| 1885 | 7,200 | 6,400 | 1913 | 17,970 | 12,100 |
| 1886 | 6,500 | 9,900 | 1914 | 16,600 | 11,000 |
| 1887 | 6,500 | 5,700 | 1915 | 17,190 | 8,900 |
| 1888 | 5,400 | 7,500 | 1916 | 17,374 | 5,100 |
| 1889 | 7,350 | 8,800 | 1917 | ---------- | 4,300 |
| 1890 | 6,600 | 4,100 | 1918 | 19,700 | 3,800 |
| 1891 | 6,800 | 6,500 | 1919 | 15,600 | 3,700 |
| 1892 | 7,900 | 7,800 | 1920 | ---------- | 4,100 |
| 1893 | 9,500 | 8,000 | 1921 | 16,200 | 3,900 |
| 1894 | 12,500 | 6,900 | 1922 | 19,560 | 4,500 |
| 1895 | 11,100 | 11,000 | 1923 | 14,987 | 5,800 |
| 1896 | 10,000 | ---------- | 1924 | 13,666 | 6,400 |
| 1897 | 10,400 | 11,600 | 1925 | 11,560 | 6,200 |
| 1898 | 11,200 | 11,600 | 1926 | 11,140 | 6,500 |
| 1899 | 12,400 | 11,800 | 1927 | 10,681 | ---------- |

[1] In certain years when production statistics were lacking, export figures have been used.

Constantinople is the principal mohair market of Turkey. This city has been known as a mohair market for many years, and the banks have looked upon mohair and wool as more solid and stable investments than most of the other export products of Turkey and have felt justified in granting more extensive credits to the exporters of mohair. Then too, this trade is reported to be concentrated among a limited number of responsible merchants who are favorably known in local business and banking circles, as well as in the more important consuming centers.

Table 10 shows the number of bales of mohair sold on the Constantinople Bourse from 1922 to 1926. These bales weigh from 168 to 182 pounds each.

TABLE 10.—*Number of bales of mohair sold on the Constantinople Bourse, 1922–1926*

| Year | Bales | Year | Bales |
|---|---|---|---|
| 1922 | 66, 903 | 1925 | 14, 106 |
| 1923 | 38, 233 | 1926 | 21, 529 |
| 1924 | 31, 484 | | |

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In Turkey the local mohair merchants usually pay cash for stocks purchased from the growers and then deposit these stocks and apply to the bankers for loans. Such advances or loans granted by the banks usually range from 60 to 80 per cent of the value of these deposits, but occasionally they run even higher for the better-known firms.

South Africa produces about one-half of the mohair which enters into international trade. Port Elizabeth, South Africa, is one of the largest primary mohair markets in the world and handles nearly 90 per cent of the South African clip. Until 1921 much of the mohair marketed in Port Elizabeth was sold at auction, but since that time practically all of the mohair has been sold at private sales. Usually the mohair is owned by the Port Elizabeth merchant who offers it for sale, but sometimes it is sold for the account of the grower who has shipped it on consignment. As a rule, however, the merchants go into the "back country" and buy the mohair themselves.

Table 11 shows the total exports of mohair from South Africa from 1906 to 1926 and plainly indicates the great importance of the United Kingdom as a market for the South African clip.

TABLE 11.—*Union of South Africa: Exports of mohair by countries, 1906–1926*

| Year | United Kingdom | United States | Germany | France | All others | Total |
|---|---|---|---|---|---|---|
| | *1,000 pounds* | *1,000 pounds* | *1,000 pounds* | *1,000 pounds* | *1,000 pounds* | *1,000 pounds* |
| 1906 | 15, 584 | 5 | 52 | | 85 | 15, 726 |
| 1907 | 18, 604 | | 97 | | | 18, 701 |
| 1908 | 18, 067 | | 73 | 42 | 5 | 18, 187 |
| 1909 | 19, 571 | | 77 | | | 19, 648 |
| 1910 | 17, 662 | 1 | 154 | | | 17, 817 |
| 1911 | 20, 876 | | 177 | | 12 | 21, 065 |
| 1912 | 23, 284 | 36 | 129 | | 31 | 23, 480 |
| 1913 | 17, 138 | | 140 | | 78 | 17, 356 |
| 1914 | 18, 845 | | 20 | | 1 | 18, 866 |
| 1915 | 12, 261 | 4, 037 | | | 8 | 16, 306 |
| 1916 | 11, 606 | 5, 726 | | | | 17, 382 |
| 1917 | 2, 800 | 1, 671 | | | | 4, 471 |
| 1918 | 14, 724 | 4, 699 | | | 222 | 19, 645 |
| 1919 | 14, 415 | 2, 502 | | | 25 | 16, 942 |
| 1920 | 6, 083 | 151 | | 34 | 56 | 6, 324 |
| 1921 | 16, 072 | 995 | 18 | 20 | 24 | 17, 129 |
| 1922 | 21, 634 | 4, 047 | 72 | 35 | 15 | 25, 803 |
| 1923 | 14, 099 | 1, 142 | 132 | | 31 | 15, 404 |
| 1924 | 12, 240 | 1, 391 | 25 | 8 | 12 | 13, 676 |
| 1925 | 10, 937 | 1, 004 | 59 | 13 | 17 | 12, 030 |
| 1926 | 5, 804 | 3, 886 | 35 | 12 | 20 | 9, 757 |

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Great Britain and the United States are by far the largest buyers of Turkish and South African mohair. Tables 12, 13, and 14 show the imports of the United States from 1922 to 1927 and imports and exports of the United Kingdom from 1900 to 1926. The United States imports about 3,000,000 or 4,000,000 pounds of mohair as a rule but in 1926 imported over 10,000,000 pounds. Germany is also an important manufacturer of mohair but buys much of its raw material in the form of yarn from England. The only other countries manufacturing mohair to any extent are France, Belgium, and Italy.

TABLE 12.—*United States: Imports of mohair, by countries, 1922–1927*

| Year | Imported from— | | | | |
|---|---|---|---|---|---|
| | Turkey | Union of South Africa | United Kingdom | All others | Total |
| | *1,000 pounds* | *1,000 pounds* | *1,000 pounds* | *1,000 pounds* | *1,000 pounds* |
| 1922 [1] | 555 | 1,522 | 1,660 | 7 | 3,744 |
| 1923 | 1,649 | 1,142 | 1,705 | 108 | 4,604 |
| 1924 | 913 | 1,391 | 2,045 | 238 | 4,587 |
| 1925 | 268 | 1,004 | 487 | 9 | 1,768 |
| 1926 | 3,890 | 3,886 | 2,874 | 16 | 10,666 |
| 1927 | 1,274 | 1,047 | 80 | 98 | 2,499 |

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[1] September 22 to December 31 only. Mohair was not separately classified prior to September, 1922.

TABLE 13.—*United States: Imports and exports of mohair and mohair manufactures, 1926 and 1927*

| Item | Unit | Imports | | Exports | |
|---|---|---|---|---|---|
| | | 1926 | 1927 | 1926 | 1927 |
| Mohair | Pounds | 10,666,493 | 2,498,804 | 291,685 | 322,919 |
| Mohair yarns | do | 326,652 | 115,009 | | |
| Mohair fabrics | Square yards | 148,199 | 571,611 | 98,783 | 111,350 |
| Do | Pounds | 40,121 | 119,393 | 54,822 | 45,655 |
| Woven fabrics of mohair and wool | Square yards | 19,948,238 | 22,421,480 | | |
| Do | Pounds | 10,312,431 | 11,210,071 | | |

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TABLE 14.—*United Kingdom: Imports and reexports of mohair, by countries, 1900–1926*

| Year | Imported from— | | | Reexported to— | | | |
|---|---|---|---|---|---|---|---|
| | South Africa | Turkey | All others | United States | Germany | Russia | All others |
| | *1,000 pounds* | *1,000 pounds* | *1,000 pounds* | *1,000 pounds* | *1,000 pounds* | *1,000 pounds* | *1,000 pounds* |
| 1900 | 9,040 | 8,537 | 468 | 209 | 13 | 332 | 12 |
| 1901 | 10,616 | 9,102 | 180 | 96 | 151 | 329 | ---- |
| 1902 | 18,242 | 11,518 | 269 | 1,835 | 78 | 447 | 2 |
| 1903 | 15,756 | 12,131 | 149 | 2,189 | 17 | 316 | 14 |
| 1904 | 13,984 | 10,810 | 796 | 2,596 | 18 | 1 | 37 |
| 1905 | 12,530 | 12,526 | 106 | 1,230 | 6 | 50 | 16 |
| 1906 | 15,584 | 10,627 | 1,232 | 512 | 635 | 103 | 43 |
| 1907 | 19,126 | 11,652 | 556 | 503 | ---- | 234 | 4 |
| 1908 | 17,810 | 7,461 | 112 | 463 | 59 | 230 | 6 |
| 1909 | 19,444 | 10,803 | 87 | 433 | 1 | 330 | 1 |
| 1910 | 18,574 | 11,286 | 91 | 830 | ---- | 119 | 96 |
| 1911 | 18,712 | 6,534 | 263 | 308 | ---- | 241 | 50 |
| 1912 | 24,410 | 10,539 | 782 | 988 | ---- | ---- | 16 |
| 1913 | 18,523 | 10,402 | 391 | 1,490 | ---- | ---- | ---- |
| 1914 | 17,592 | 9,007 | 161 | 1,182 | ---- | ---- | 22 |
| 1915 | 14,186 | ---- | 45 | 3,411 | ---- | ---- | 117 |
| 1916 | 11,215 | ---- | 58 | 124 | ---- | ---- | 144 |
| 1917 | 3,545 | ---- | 31 | 5 | ---- | ---- | 32 |
| 1918 | 5,582 | 17 | 4 | ---- | ---- | ---- | 15 |
| 1919 | 19,267 | 9,131 | 1,010 | 56 | ---- | ---- | 55 |
| 1920 | 5,841 | 5,186 | 443 | 525 | 73 | ---- | 132 |
| 1921 | 15,308 | 2,314 | 1,498 | 1,093 | 277 | ---- | 19 |
| 1922 | 20,897 | 11,479 | 874 | 3,770 | 16 | ---- | 119 |
| 1923 | 13,823 | 7,218 | 1,509 | 1,651 | 56 | ---- | 86 |
| 1924 | 14,044 | 5,612 | 1,228 | 2,209 | 228 | ---- | 100 |
| 1925 | 10,730 | 2,119 | 564 | 529 | 94 | ---- | 77 |
| 1926 | 5,804 | 4,961 | 304 | 2,874 | 324 | ---- | 1,345 |

Bureau of Foreign and Domestic Commerce.

Raw mohair is admitted duty free into Italy, United Kingdom, Canada, Germany, France, Belgium, Czechoslovakia, and Austria. The import duty on raw mohair into the United States is based on a rate of 31 cents per clean pound. There is an export duty of one-half cent per pound on mohair shipped from Basutoland, South Africa; but there is no duty on exports from the Union of South Africa or from Turkey.

## SANITARY REQUIREMENTS FOR IMPORTATION AND EXPORTATION OF ANGORA GOATS AND MOHAIR

### IMPORTATION OF GOATS

It is a long-established rule of the United States Department of Agriculture to limit the importation of goats and like domestic ruminants to those originating in and coming forward from countries which are free from serious animal diseases, including foot-and-mouth disease. Conditions in this respect in most countries in which Angora goats are to be found are not such as to admit of their importation. As it is necessary before proceeding with a shipment to obtain a permit from the Secretary of Agriculture, it will be advisable for those contemplating the importation of goats to apply for a permit before negotiating the purchase of any such animals in a foreign country. Permits issued in these instances specify the country of origin, port and date of embarkation of the animals, and port and proposed date of arrival in the United States. It is necessary to have consign-

ments accompanied by a certificate from the chief Government veterinary officer of the country of origin showing that the animals in question have been kept in said country for 60 days immediately preceding the date of movement therefrom and that the country during such period has been entirely free from certain specified diseases. Upon arrival at the port of entry, goats are subjected to a careful inspection and if found eligible to land are allowed to proceed to the quarantine station for the port, where they are held at the expense of the importer for a period of not less than 15 days.

### EXPORTATION OF GOATS

In case breeders in the United States find a foreign market for their goats, they will experience no great difficulty in meeting requirements of the United States Department of Agriculture for such shipments. These relate more especially to measures that assure the safe and humane transportation of animals on ocean vessels. It is customary for the Bureau of Animal Industry to inspect export animals of this kind on the farm from which they are to be shipped, to supervise their loading at the port of embarkation, and to issue a certificate showing freedom from disease. It is always advisable for a shipper before proceeding with an export consignment to communicate with the nearest consul in the United States representing the country to which his animals are destined and obtain from him information regarding the existing requirements of his Government. The Bureau of Animal Industry is prepared to make inspections and so far as possible issue certificates to meet regulations of receiving governments.

### IMPORTATION AND EXPORTATION OF MOHAIR

As the mohair trade is closely related to Angora goat husbandry, it may interest breeders to know what United States Government requirements, aside from the tariff, may have an influence upon the importation and exportation of goat hair. For a period of years there have been regulations of the Department of Agriculture in effect governing the sanitary handling of importations of this kind. They are designed to prevent introduction into the United States of diseases of livestock, more especially anthrax, foot-and-mouth disease, and rinderpest, through the medium of such products. It is provided that clipped mohair if unmixed with other hair or wool of any kind may be imported without restrictions. This likewise holds true of scoured mohair or hair removed from skins by the liming process. Where hair is taken from animals found free from certain diseases when slaughtered under national Government inspection in a country and in an abattoir in which is maintained an inspection service found by the Secretary of Agriculture to be substantially equivalent to the Federal meat inspection service of the United States, it may be imported without restrictions. It must, however, be accompanied by a specified form of certificate covering these requirements and signed by a recognized official veterinary inspector of such country. As these regulations are subject to amendment, importers of mohair will find it to their advantage to

retain in their files copies of the latest regulations affecting materials of this kind.

There are no restrictions by the United States Department of Agriculture upon the exportation of mohair, which may be shipped subject only to requirements of the country to which it is destined.

## STANDARDIZATION OF MOHAIR GRADES

Standardization requires first the formulation of definite measures of fineness, length, strength, luster, color, spinning qualities, and other properties of mohair, and then the classification of the various kinds of mohair into definite well-defined grades which represent differences in market value and which are broad enough to cover the range of quality and condition of the mohair commonly found in commerce and at the same time sufficiently narrow so that the transacting parties are not obliged to resort to contractual specifications to protect their interests or to insure their needs. Standardization should stabilize business by providing a common, understandable language within the trade which will be uniform throughout the commercial world and by which mohair may be accurately, completely, and satisfactorily described, thus obviating the necessity of personal inspection.

Standardization is necessary to the marketing of mohair on sound business principles, and the mohair industry will not be on a proper business basis until its products are sold under a statement of quality measured by a recognized standard. With no standardized grades in use the buyer often pays a blanket price to the growers regardless of the quality of the product that they deliver, thus overpaying the producers of low-quality mohair, and underpaying the producers for high-quality mohair. This is due, partly, to the distance between the region of production and the consuming centers, which places a limitation on personal contact between buyer and seller. In the absence of definite criteria on which to base his judgment, the buyer is compelled by the forces of competition to protect himself by adopting the seemingly unfair practice of paying a blanket price regardless of quality.

A further advantage of standardization is that it enables the grower to know whether he is receiving full market value for his mohair, for he can secure adequate and reliable market information which is impossible unless the mohair grades are universally recognized so that the buyer in Boston and the grower in Texas use exactly the same terms in describing the same quality of mohair. This is especially valuable in the case of mohair which has to compete with the clips of Turkey and South Africa.

Then, too, official standards make possible the employment of uniform methods and practices in the grading and in the preparation of the graded product. If mohair clips are pooled and graded so that the manufacturers could purchase exactly the grade desired and nothing else, it would enhance the price of mohair. No manufacturer can afford to pay as much per pound for mohair, if, in order to secure 5,000 pounds of a given grade, he has to purchase 10,000 pounds of mohair to insure a sufficient supply of the exact grade needed and then must dispose of the remainder at whatever price

he can get, or hold it in stock until required for manufacture of goods for which it is suitable.

The use of mohair standards may be expected to bring about a closer relationship between the producer and those who are engaged in the handling, financing, merchandising, and manufacturing of mohair. A lack of such relationship prevents effective cooperation and results in a lack of confidence between producers and consumers. In this regard it is well to remember that mohair standards are not devised primarily to settle disputes but rather to prevent them. Through standards each party to a transaction has a clear understanding of what is meant by each term, grade, or classification used.

Mohair breeders should have a practical knowledge of the quality of their clips and should pay considerable attention to the grading of their fleeces. This aids in obtaining a price commensurate with the value of their clips and, if the clips are of inferior quality, it provides a basis for intelligent breeding for the production of the more valuable types of mohair. As long as mohair is sold principally on the basis of weight, there is a tendency to produce a coarse, heavy fleece which is not so desirable for manufacturing purposes and from which the finer grades of merchandise can not be made. Care in the selection of goats to be used for breeding purposes will improve the product, and if these fleeces are properly graded the resultant increase in value will repay the extra effort required.

The problem of mohair standardization is complex, involving as it does the properties of diameter of fiber, length of staple, luster, spinning qualities, and shrinkage (which includes scouring loss and vegetable matter loss) each of which shows a wide variation. It is not possible for the producer to fix the size and shape of a mohair fiber, to regulate absolutely the quantity of oil and foreign matter in the mohair, nor to predetermine the spinning quality of the fiber. It is possible, however, to simplify nomenclature, and to set up standards, for all factors, that will be workable in commerce.

In attempting the development of mohair standards, it was deemed advisable to consider one factor at a time, and diameter of fiber was selected as the basic factor on which to begin the work, as all of the other factors are more or less related to this. Figure 37 shows the proposed United States standards for grades of mohair. These standards show the mohair classified as combing or carding according to its length, and as Nos. 1, 2, or 3 according to its diameter.

Standardization is important for financing purposes. Many growers can not afford to hold their mohair for a long period after shearing. All too frequently the result is that too many people put their product on the market at the same time, thereby causing the immediate supply to exceed the demand.

This condition contributed in no small measure to the impetus given to growers' cooperative associations during the last few years, but they, like the individual farmer, must market their product over a period or the primary purpose of the association is defeated. To market over a period of six months creates the need for financing the farmer or the association during this period. With proper standards as measures of the value of the products while in storage, the field of credit is not only enlarged but the rates at which loans can be secured are frequently lowered.

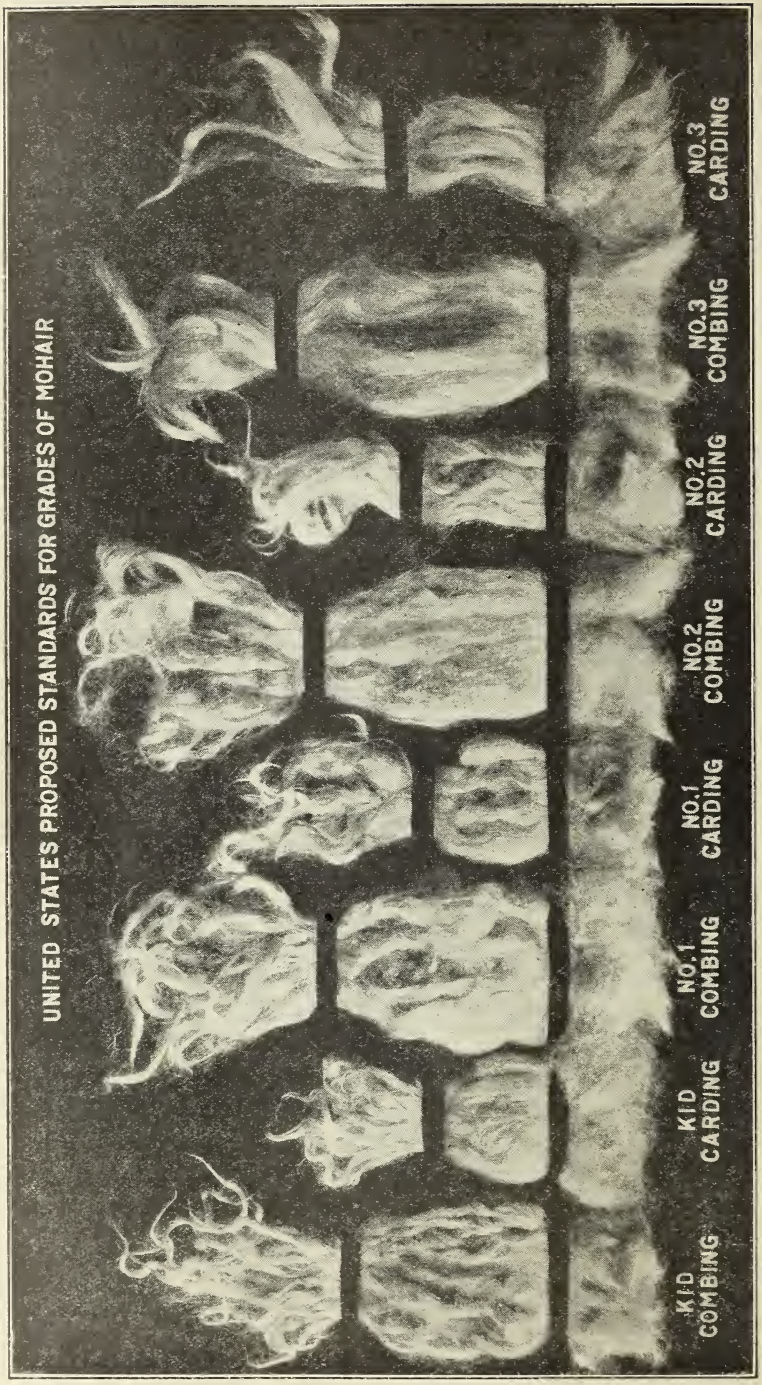


FIG. 37.—Proposed United States standards for grades of mohair

This is strikingly illustrated through the operation of the United States warehouse act (*24*). This law specifically covers the form of warehouse receipt which a warehouseman may issue, and it requires that the grade be stated on the receipt and that a statement be made showing under what standards the grades were determined. It specifically requires that for all products for which United States or Federal standards have been promulgated they must be used for this purpose. The importance of grades is further shown by the action of leading banks in New York and other cities which have urged the use by clients of the Federal warehouse receipt with the grades stated thereon so that they might have a just idea of the value of the commodities on which they are asked to make loans.

If it is not feasible or practicable to classify mohair according to quality at the shearing pen, great benefits will be derived by growers and manufacturers if the fleeces are segregated according to sex and age, as follows: Kids, yearlings, bucks, and does. Each kind should be packed separately and marked accordingly. If mohair is packed this way, the grower receives better returns, for the manufacturers prefer to purchase fleeces that are so packed, because it facilitates sorting. Mohair must be sorted at the mill by qualified and experienced sorters before it can be manufactured into yarn. The sorting operation is slow because of the dust and minute fibers which annoy and inconvenience the sorters. Moreover, as a mohair fleece does not cling together as a wool fleece does, it must be handled much more carefully. A practical demonstration would be necessary to illustrate the many difficulties which arise during the process of mohair sorting.

## MANUFACTURING PROCESSES FOR MOHAIR FABRICS

The mohair fiber, especially in the finer grades, is used in the manufacture of suiting and upholstering material. It is well adapted for conversion on combing machinery, and hence it is usually made into yarns on the worsted system of manufacture known as the Bradford system. Briefly this system consists of preparing the fiber for the machines, scouring it free of dirt, combing or parallelizing the fiber and removing short staple, and spinning.

Actually there are a large number of processes, but only a small percentage of mohair passes through all of them. The number of processes used depends on the type and quality of the fiber and its intended use. The processes listed below are the maximum number to which an undyed mohair fabric would be subjected.

Cleaning operations: Sorting; scouring; drying; and oiling.

Combing operations: Carding; preparing; back washing, drying, and oiling; finishing-can gill box (twice); combing, (1) Lister comb, (2) Noble comb, (*a*) punch, (*b*) comb; and finishing gilling, (1) can gill box, (2) top gill box;

Drawing operations: Can gill box (twice); two-spindle gill box; heavy drawing box; weigh box; finisher box; fine finisher box; reducers; and rovers.

Spinning operations.

## CLEANING OPERATIONS

The first steps in preparing the mohair fibers for manufacture into fabrics are to eliminate as many and as much of the natural and foreign impurities as possible. This is accomplished by a series of processes known as the cleaning operations. Sorting, scouring, drying, and oiling comprise the series.

### Sorting

The first step in the manufacturing process is sorting—the separation of the individual fleece into the divisions, varieties, and qualities which best suit the requirements of the yarn and fabric to be ultimately spun and woven. To obtain a uniform yarn as the final product, the coarse grades must be separated from the fine, and various gradations in the degree of fineness in between. The sorting is accomplished by hand. The fleece is laid open upon a sorting table with a wire-screen top through which any loose dirt, straw, or other loose impurities may fall. Some tables are equipped with exhaust fans that facilitate the removal of these impurities. To divide the fleece into the different qualities, or sorts, that are usually understood to be the standard kinds, the nature of the fleece must be thoroughly understood, as each section will vary in grade, quality, staple, and strength depending on the location upon the body of the animal. Stained or off-colored locks of fibers are removed.

### Scouring

The animal in grazing picks up and holds in its fleece, due to the natural grease present and the matted nature of the fibers, considerable foreign impurities in the form of sand, loam, dirt, shives, straw, and seeds. This, coupled with the natural impurities, grease or yolk, and perspiration, comprises about 15 to 25 per cent of the fleece, by weight.

The removal of as much of these impurities as possible before further processing is accomplished by means of washing and cleaning the mohair in a solution of soap, alkali, and warm water. This process is called scouring.

The solution of alkali and soap in warm water is contained in long tanks, or scouring bowls, varying in length from 16 to 37 feet. The mohair is gradually fed in and slowly immersed in the liquid. To obtain an open, free, and lofty or fluffy product, the material must be agitated only sufficiently to open it. This is accomplished by means of a series of rakes which slowly carry the material forward a short distance in the scouring liquor, and parallel to the bottom of the bowl; then the rakes withdraw from the liquor in a vertical line. When the teeth are entirely withdrawn they return to their original position and again enter the liquor. After passing down the full length of the bowl the fibers are automatically removed from the liquor, passed through a pair of nips or squeeze rolls, and then deposited in a second bowl.

The second bowl also contains scouring liquor consisting of a solution of alkali and soap in warm water, the strength of which is less than that in the first, that is less soap and alkali are used. Here the

operation is repeated. The mohair then passes through a third and a fourth bowl, each containing solutions of soap (no alkali) in warm water. Finally it is rinsed in a fifth bowl, which contains clear warm water alone. Then it passes once more through a pair of nips or squeeze rollers before being sent to the drying process.

The temperature and strength of the liquids must be carefully controlled. The use of water too hot, or an excessive amount of alkali, will not only remove the grease or yolk, but will also attack the fatty substances of the structural cells and render the fibers hard and brittle.

Precaution is taken, owing to the harmful action of free caustic and potash, that the soap used shall be neutral. The alkalies used are either carbonate of soda or carbonate of potash. The amount of soap and alkali used depends upon the amount of impurities in the mohair. Excessive use of alkali is avoided as previously stated.

The hardness or softness of the water used is of vital importance and varies according to the proportion of salts, lime, chalk, and other ingredient minerals it contains. When hard water is used in scouring, without being previously softened, the mineral constituents react with the soap forming insoluble lime or magnesium soaps, which cling to the fiber and are difficult to remove. Their presence is one of the immediate causes of spotty and uneven dyeing.

### Drying

The drying operation follows scouring. The principle of all drying operations is the removal of the moisture remaining after scouring, by means of a current of hot air. This is accomplished by two methods: The table (or screen) dryer (largely superseded); or the apron dryer.

The table-drying method consists of placing the material to be dried on a table covered with a screen. The table is shaped like a low-pitched peaked roof. A current of hot air is blown up through the mohair.

Apron dryers are built in single and multiple units. In the single-apron dryer the material is carried forward by an endless belt for a considerable distance. In the multiple system two or more aprons are placed one above the other in such a manner that the receiving end of the bottom one extends beyond the delivery end of the one above. The travel of each belt is the reverse of the preceding. In the single-apron dryer the hot air is sucked down through the material; in the multiple system the hot air is circulated up through the mohair, striking the driest material first. The aprons are inclosed in a wooden housing.

### Oiling

Oil is applied to mohair after the scouring and drying operations, to lubricate and impart smoothness to the fibers and also to minimize the production of waste. This is essential as the natural lubricant has been removed in the scouring process.

The amount of oil applied is negligible as compared with the bulk of the material. To facilitate application, and to spread thoroughly and evenly the small quantity of oil over the large quantity of mo-

hair, the oil is first emulsified with water and alkali, usually sodium carbonate. Different mills use various methods of oiling the stock. In all the methods however, the principle is to apply the oil in a finely divided spray and then let the material lie for a period of time so that the oil will permeate thoroughly. It is essential that an oil be used which can be easily saponified so that it may be readily removed in the later processes.

### COMBING OPERATIONS

After the mohair has been cleansed of grease and as much dirt as possible, in the cleaning operations, the next consideration is to open it, and to lay the fibers as nearly parallel as possible with a minimum of injury. This is done by a series of mechanical processes, known collectively as combing, by which the raw material is converted into tops (balls) for further processing. In the various processes, drafting and doubling play a conspicuous part and are conducive to the production of an even, smooth yarn in which the fibers of varying lengths are uniformly distributed.

The word drafting is applied to the principle of attenuating, or drawing out, a comparatively large mass of fibers to the condition of a thinner but longer mass. In drafting there are three principal objects: (1) To reduce the sliver, or roving, to a less weight per yard, that is attenuating it gradually to the desired degree of fineness; (2) arrangement, and improvement of the arrangement of the fibers in a parallel order, so that they may lie side by side and overlap one another; and (3) the evening of the sliver, or strand of fibers, to eliminate thick and thin places, which is aided considerably by doubling.

The explanation just given shows that attenuating the mass of fibers tends to reduce its thickness and to make a thin sheet where there was formerly a thick one. If this is continued indefinitely it will result in destroying the continuity of the sliver. To prevent this doubling is resorted to. Briefly explained, two or more slivers are fed into each machine, and are delivered at the front rolls, or delivery rolls, as a single strand. This not only helps to compensate for the excessive attenuation but helps to neutralize the unevenness of the original mass of fibers fed in. In this manner the thick and thin places of any one sliver are combined with other slivers of normal size, or thick places with thin ones. The combination of two or more independent slivers, which are drawn out into one, results in an evenness not otherwise attainable.

In practically all of the following processes, including the combing, drawing, and spinning operations, the principle of drafting and doubling is one of the main essentials.

#### Carding

Carding is the first of the combing processes. The primary object is the separation of the fibers one from another in order to prepare the mohair for the combing process; to arrange the fibers into a continuous, untwisted sliver (or strand), all parts of which are equal in weight and thickness, and so blended that all sections contain fibers of every length and quality; to remove as far as possible the knots, seeds, shives, and other foreign material not removed in scouring.

The card consists of a series of cylinders, large and small, covered with wire ranging from coarse at the feed end to fine beginning at the main cylinder. (Fig. 38.) The wire entirely covers the cylinders and is bent at an angle of approximately 45°. The length of the wire is three-eighths of an inch with the exception of the fancy roller, the wire of which is 1 inch long.

The material to be carded is fed intermittently, and in definite weighed quantities, to the feed sheet, *a*, whence it is fed by means of the feed rollers, *b*, to the first licker-in *e*. The material is then removed from *e* by the first top divider, *f*, and delivered in order to the licker-ins and dividers, *g*, *j*, *i*, *h*, *k*, and *l*. The rate of surface speed of the licker-ins, *e*, *g*, *i*, and *k*, vary, starting slowly with *e* and gradually increasing through *g*, *i*, and *k*. The dividers *f*, *h*, *j*, and *l*, travel at a much lower rate of surface speed than the first licker-in *e*, and the rate of surface speed of each is the same. The wire covering of all of these rollers is coarse. This is necessary as the fibers are more or less entangled and must be gently opened.

It is well known that if long and slightly matted hair be combed rapidly with a fine-tooth comb, the teeth will catch in the interlacings and tighten them until they become knots, and that a large number of hairs will be broken or pulled out by the roots. But, if a very coarse-tooth comb is used first, and slowly drawn many times through the hair, the fibers will be gradually separated until the work may be finished with a fine-tooth comb. This will result in straightening and separating the fiber, with little or no damage to it. Beginning with the main cylinder, *m*, all of the rolls are covered with fine wire. The second bottom divider, *l*, delivers the material to the main cylinder, *m*. This cylinder travels at a high rate of surface speed and carries the material forward to the workers, *n*, and the strippers, *o*, where the main carding is accomplished. The material is carried by the strippers to the workers. The workers, *n*, act as a comb and straighten the fibers, removing some of them from the main cylinder. This

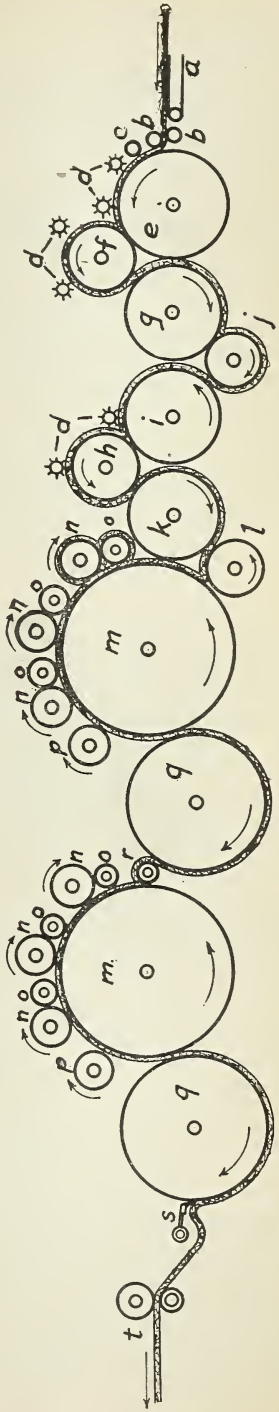


FIG. 38.—Double-cylinder worsted card

action is called carding to distinguish it from the process of combing.

The material picked up by the worker is stripped, or removed from it by the strippers, *o*, and delivered back to the main cylinder. Each main cylinder has three sets of workers and strippers. The workers travel at a very low rate of surface speed. The strippers travel at a rate of surface speed about one-fourth of that of the main cylinder.

After the material has been carried by the workers and strippers, the fancy roll, *p*, raises it to the surface of the wires, whence it is removed by the doffer, *q*. The surface speed of the fancy is about one and one-quarter times that of the main cylinder—this is to facilitate the raising action. The doffer travels at a low rate of surface speed, even less than that of the first licker-in, but greater than that of the workers.

The mohair is next delivered to the second main cylinder through the medium of the angle stripper, *r*. The action on the second main cylinder is the same as that on the first. After doffing, however, the material is removed from the doffer by means of the doffer comb, *s*, which vibrates at a high rate of speed. The mohair is then condensed into a sliver, or strand, and wound into balls or deposited in cans.

### Preparing

An alternative method of preparing the mohair for combing is by means of the preparing gill box. To distinguish the preparing gill boxes from the gill boxes, used later in the manufacturing processes, they are called preparers. The card is exceptionally suitable for short-staple mohair, and the preparer is better adapted to handle the long-staple mohairs. The length of the material largely determines which method to use; that is, carding or preparing. The type of yarn ultimately required must also be considered; if luster of a maximum amount is required, then preparers are employed because of the superior parallelization of the fibers in the preparer as compared with the card.

A set of preparing machines usually consists of six operations, namely, two or three sheeting boxes, and the remainder can boxes.

The function of the preparers is to open the mohair, to straighten the individual fibers, and to lay them as nearly parallel as possible.

A sheeting preparer consists chiefly of two pairs of rollers with a number of bars, with two rows of pins each, working between them. These bars are termed fallers and are carried forward toward the front or delivery rollers by means of suitably threaded screws. Each faller upon reaching the front rollers is depressed by cams on the screws, and is then returned towards the back rollers, or feed rollers. This is accomplished by a pair of bottom screws which are cut double the pitch of the top screws, thus reducing the number of fallers necessary per set. Cams are fitted on the bottom screws to lift the fallers to the top screws again.

The mohair is fed to the back rollers between two converging aprons, and while it is held in the nip of these rollers it is pierced by the faller pins as the faller works into the top screw. The surface speed of the fallers is greater than that of the back rollers and the material is opened and combed by the action of the fallers.

While the fiber is held by the back rollers it, of course, receives more combing action than after it has left the nip. This material is merely carried forward by the fallers until it is gripped by the nip of the front rollers. At this point it is drawn through the pins owing to the greater speed of the front rollers. In this manner the entire length, or nearly the entire length, of the fibers is combed out somewhat. At the same time, due to the difference in speed between the rollers and fallers, there is a drafting action. The mohair is then delivered onto a cloth apron where it is allowed to form a lap, or sheet, of suitable dimensions. When the desired amount has accumulated the sheet is broken off and is ready to submit to the next process.

The method of treating the mohair on the can box preparers is identical with the sheeting preparers, with the possible exception of one or two minor details, principally that the product is deposited in cans.

The diameter of the pins, the length of the pins, and the number of pins per faller in each machine varies. In the first sheeter the coarsest pins, the largest pins, and the least number of pins are used; the number increases and the diameter and length decreases as the material advances through the various stages of preparing.

Here again the simile of combing out snarled hair can be applied. (See p. 97, " Carding.")

### Backwashing

After the scoured mohair has been thoroughly opened on the card, or on the preparer, it is somewhat discolored, somewhat dingy in consequence of dirt not entirely removed in scouring, and the oil used after scouring which causes a considerable amount of dirt to adhere to the fibers. It is very desirable to remove these impurities and to cleanse the mohair thoroughly of all grease and foreign materials before it is further processed. This is done on the backwashing machine.

The principal mechanisms of the backwasher (fig. 39) consist of a pair of feed rollers; two small scouring bowls, or tanks, with squeeze rollers, or nips, attached, and one bowl located above the other; a device for reoiling the stock; and a gill box. (Fig. 40.) The operation of the machine is very simple.

To obtain uniformity of weight and blend of material, a number of cans from the preparing processes, or a number of balls from the card are doubled at the feed end. The feed rollers deliver the mohair to the lower of the two scouring bowls, where it is immersed in a solution of soap and warm water. Just sufficient soap is used to remove the dirt and form suds. As in the scouring process, the soap must be neutral; that is, there must be no free alkali.

As the mohair is treated in the sliver form, there can be no agitation by forks or by other means, therefore squeezing is the only method of removing the dirt. This is accomplished by two pairs of squeeze rollers submerged in the bowl, and a third pair located at the delivery end and just above the surface of the scouring liquor. The lower roller of each pair of nips is driven since a friction drive alone would place too much strain on the mohair sliver. Pressure is applied by weighting the top rollers.

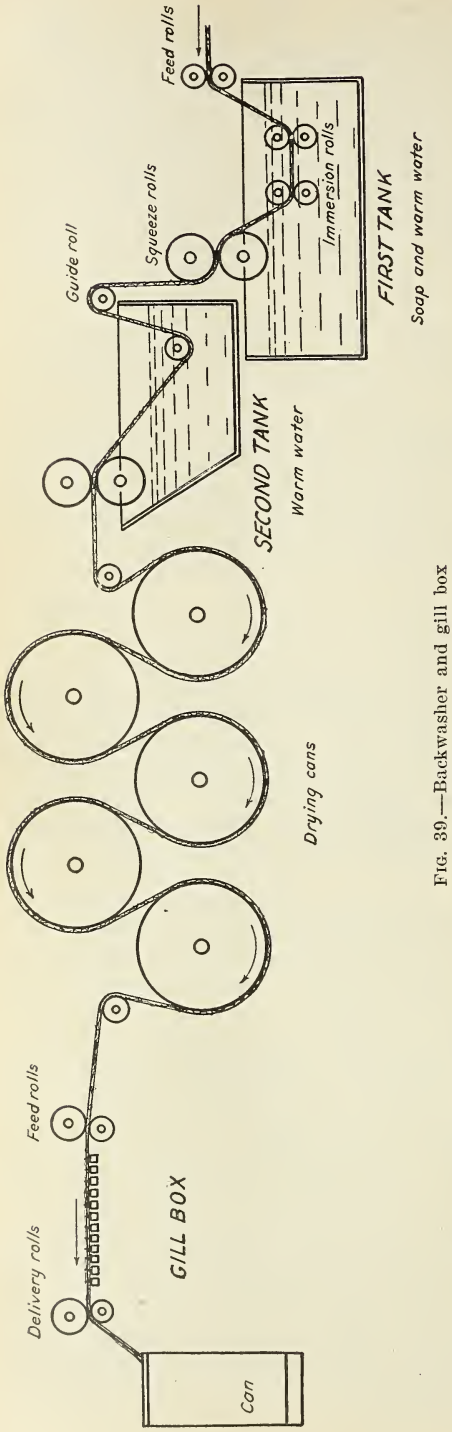


Fig. 39.—Backwasher and gill box

The mohair next enters, and is immersed in the top bowl, which is filled with clear warm water. Since the purpose of this bowl is merely to rinse out the soap left in the sliver, squeeze rollers located in the liquid are not necessary. A pair of nips is located at the delivery end of the bowl.

When mohair is run through bowls made up in this manner, it is found that the lower bowl loses most of its soap which is transferred to the top bowl. So long as the top bowl contains only a little soap there is no difficulty in removing all that is carried forward from the lower bowl. But, as the soap in the top bowl gradually increases in strength, much of the soap is carried through the final squeeze roller by the mohair, unless the clear water is renewed. All of the soap which is carried forward is dried on the mohair, and in extreme cases it will affect the "handle" of the material, and later tend to cause streaks in dyeing. The simplest way to keep the liquors in the bowls uniform is to run warm water continuously into the top bowl at such a speed that the soap strength and temperature will remain constant. By means of an overflow, the excess soap will flow down to the lower bowl. An occasional addition of a little soap will keep the lower bowl at the desired strength.

From the last pair of squeeze rollers the mohair goes to the steam-heated cylinders to be dried. There are six of these cylinders, and they are arranged in such a manner that first one side and

then the other side of the sliver is in contact. Sometimes the cylinders are encased, and a blast of hot air is used to assist in the drying.

As the mohair leaves the cylinders of the dryer, oil is again applied to the sliver in the form of an emulsion, the quantity being regulated by the requirements of the mohair. It is necessary that the oil emulsion be applied evenly and constantly while the machine is in motion, and to stop when the machine stops. A simple device is to have a positive-driven tin cylinder rotate in a trough of the oil emulsion. The surface of the cylinder carries with it a thick film of oil which is scraped off by a number of strips of tin. The oil is thus transferred to the strips of tin, or conductors as they are called, and drops down onto the mohair. The amount of oil applied can be regulated by increasing or decreasing the number of conductors.

After oiling, the mohair passes through a gill box attached to the backwasher. The function and operation of the gill box has been described under "Preparing" (p. 98).

### Finishing Can Gill Boxes (Twice)

After backwashing and gilling, the mohair is passed through two more operations of gilling. These operations, the same as gilling

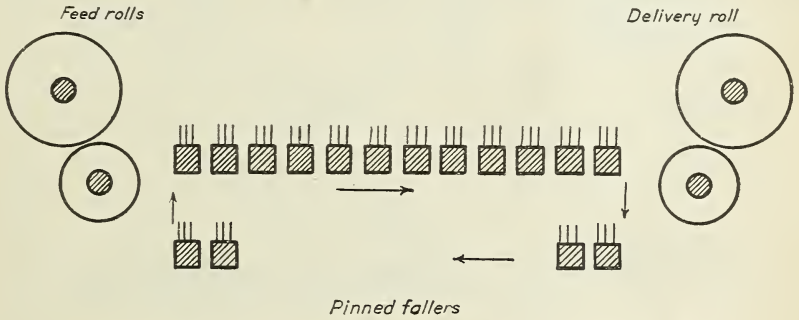


Fig. 40.—Gill box

described under preparing, are for the purpose of opening the mohair thoroughly. This will prevent many of the long fibers from being combed out with the short ones in the combing process. The operation is carried out by means of rollers and fallers.

### Combing

In combing there are two objects to be attained: (1) To separate the short from the long fibers; and (2) to lay the long fibers in parallel positions.

Gill boxes, although they produce a uniform ribbon, or sliver, in which the fibers are parallel, do not attempt to remove the short fibers. The product of the gill boxes contain fibers of all lengths, which makes the material unfit for manufacture into an even, smooth, uniform yarn. For this reason the mohair is divided, in the combing process, into two distinct classes; the long fibers, or top, which are later drawn out and made into yarns on the worsted system; and the short fibers, termed noils, which can be used only in the woolen system of manufacturing. The result of removing the short fibers, and

retaining only the longer, straighter ones, is the formation of a bright, lustrous yarn with a smooth, uniform surface and an even diameter. Hence the importance of combing.

There are several classes of combs, but the principal types are the nip motion and the circular motion.

### LISTER COMB

The Lister comb (fig. 41) is a long-wool comb and is used principally to comb long wools, mohair, alpaca, etc. The material is fed into the comb by means of a pair of feed rollers and is immediately acted upon by a gill box, the fallers of which are curved. A brush is employed to dab the mohair thoroughly into the teeth of the fallers. In place of delivery rollers the gill box has a curved nip, capable of being traversed, which seizes the tufts of mohair projecting from the fallers. The curved nip then moves forward and draws the fibers through the pins, thus clearing one end.

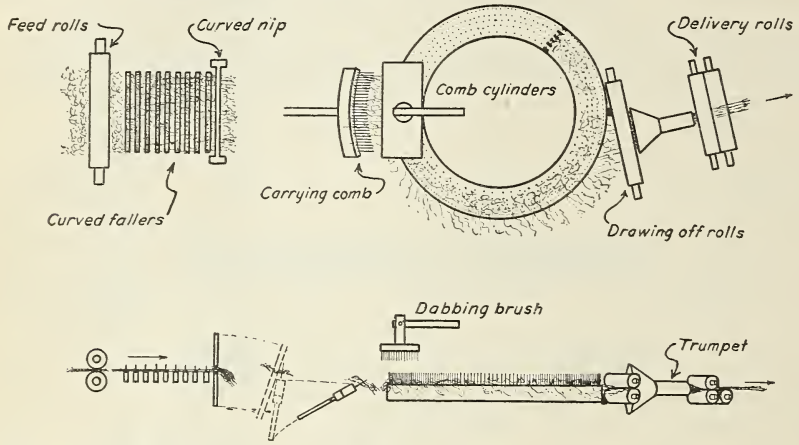


FIG. 41.—Lister comb

The curved nip consists of two jaws upon a swinging frame which imparts the traverse motion. The jaws are capable of opening and closing at proper moments to seize or release the mohair.

The mohair is removed from the circular nip by a traversing comb, known as a carrying comb, and conveyed to the comb circle. The carrying comb is fitted with long teeth; moreover it is moved back and forth from the vertical to the horizontal, so as to leave the fringe of mohair hanging over the pins of the comb circle. A dabbing brush descends and presses the mohair into the pins of the comb circle.

The comb circle is pinned around with five rows of teeth. It revolves slowly and delivers the mohair to a pair of drawing-off rollers working horizontally but set at a tangent to the circle. The long and short fibers have their root ends set deeply in the rows of pins, and, as they reach the drawing-off rollers the long fibers are the first drawn out. As the comb circle continues to rotate the medium-length fibers are drawn off at the point where the circle and the

rollers are in closest contact. The noil, or shortest fibers, remains in the pins of the comb circle and is removed by steel knives set between the rows of pins. The product (top) is condensed and deposited in a can.

### NOBLE COMB

#### *Punch*

Whatever type of comb is used, the objects are the same; to straighten and parallel the fibers and to remove the noil. The type of comb adopted determines to a large extent the manner in which the slivers from the preceding operation are fed. The Noble comb requires a special machine to convert the slivers into balls, four slivers per ball.

The machine employed, called a punch, is very simple. Four slivers are fed into the machine and wound side by side upon a square spindle with circular disks attached to each end. When a sufficiently large ball is wound, one of the disks is taken off and the ball removed from the square spindle.

Eighteen balls from the punch are required for the Noble comb (fig. 42), 72 slivers, which means 72 doublings, are fed into the machine. The principal parts of this comb are the following: (1) The large, horizontal circle with eight rows of pins, *a*, the number and diameter varying from row to row, the thickest and the least number being in the outside row; (2) two small circles, *b*, *b*, which work within and on opposite sides of the large circle, with five rows of pins. The inside row of pins is the coarsest and has the least number of pins. The outer row is almost in contact with the inside row of the large circle; (3) two dabbing brushes, *c*, *c*, to drive the mohair into the pins of the large and small circles at the point of contact; (4) the vertical drawing-off rollers, *k*, *k*, which draw away the sliver of long fibers from the circles; (5) the star wheel, or divider, *f*, *f*, for flipping the extending fringe of mohair into the path of the drawing-off rollers; (6) the feed boxes, *o*, *o*, one for each sliver; (7) the cleaning knives, *i*, noil knives, *g*, and press knives, *n*.

In combing, the balls of mohair prepared in the punch are placed on a circular reel carried around by the large circle. The material is laced through the feed boxes, or conductors, and is laid over both sides of the large circle at the points of contact with the smaller circles. The dabbing brushes descend and press the mohair into the pins of both the large and small circles. Separation of the material is effected through the continued revolution of the circles. Thus, the long fibers are drawn by the circle having the greatest hold upon them through the pins of the opposite circle. They are left hanging as a fringe on the inside of the large circle and the outside of the small circles. The short fibers, noil, remain within the pins of all the circles. The star wheel now flips the ends of the fibers in the proper direction so that they may be grasped by the drawing-off rollers.

Continuous drawing off of the combed material now takes place at four points, two on the large circle, and one on each of the small circles. These ends are united into two slivers (one on each side of the comb) and later are combined at the center of the comb where they are drawn through a revolving funnel, or trumpet, and then deposited in a can.

The noil left in the pins of the small circle is removed by stationary inclines, called noil knives, set between the rows of pins. Upon being raised to the top of the pins the noil falls over the edge of the circle into a funnel prepared for it. The small circle is ready to be filled again when it reaches the point of contact with the large circle.

The noil left in the large circle is cleared later. The long fibers, previously out of reach of the inner circles, and the noil mixed with them, are laid on the pins of the small circles. The combing action is repeated. This constitutes the feeding of the comb.

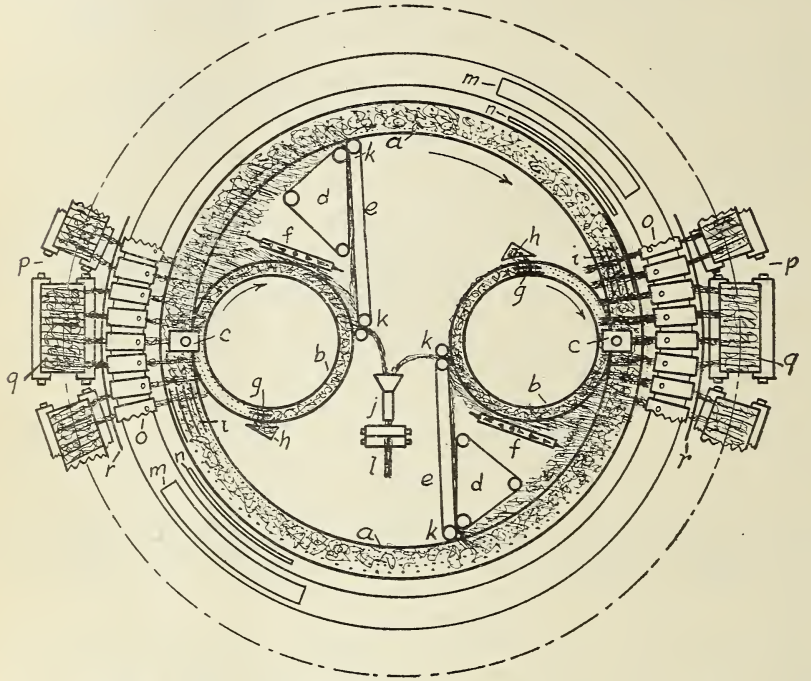


FIG. 42.—Plan of Noble comb. *a*, Large circle; *b*, small circle; *c*, dabbing brush; *d*, triangular apron; *e*, long apron; *f*, star wheel; *g*, noil knife; *h*, noil can; *i*, cleaning knife; *j*, trumpet; *k*, drawing-off rolls; *l*, delivery rolls; *m*, inclined track; *n*, press knife; *o*, feed boxes; *p*, carriage; *q*, top; *r*, feed bar

It is accomplished by running the material, the continuation of the sliver already in the pins of the large circle, under stationary press knives. The press knives are stationary steel bars located at the points of contact of the circle. The press bars hold the stock in the pins of the circle as the fore part of the feed boxes is raised. The raising of the feed boxes, which are hinged at the back, is accomplished by passing them over an inclined plane. The result of these actions is a pull at the ball and the delivery of a short length of sliver.

Upon running clear of the press knives each end of sliver is lifted by stationary lifting knives, steel bars between rows of pins on a large circle, to the top of the pins. The sliver is straightened on a

straightening plate prior to being carried over the large and small circles at the point of tangency. At this point the dabbing brushes operate, as previously explained.

### Finishing Gilling

The top sliver from the comb is run through two gill boxes before being wound into balls and taken to the drawing operations. Mohair is gilled after combing for the following reasons: (1) To blend the different lengths of fibers thoroughly since the comb does not distribute them evenly; (2) to continue the process of parallelizing the fibers; (3) to apply a quantity of water, (*a*) so that the proportion of moisture in the mohair will be uniform, (*b*) to make every yard of sliver weigh exactly the same, and (*c*) to replace any moisture evaporated during combing, in order to give the mohair its natural suppleness and condition; (4) to wind the sliver into balls, so that it will occupy the least possible space and so that the sliver may be readily unwound from them when it reaches the drawing frame.

#### Can Gill Box

The machine is built the same, and operates the same as the preparer (p. 98). The pinning of the fallers is finer, however, and the product is delivered into cans instead of in the form of a sheet.

To obtain a uniform weight of yarn, the drawing-room must receive tops of uniform weight. For this reason there is a standard of weight set for various grades of materials, the weight increasing as quality of the mohair decreases. The weight of the sliver is affected by the quantity of oil and water it holds by mechanical means; therefore it is necessary that these quantities be accurately ascertained. The oil is regulated as described under "Backwashing" (p. 99). Water evaporates very rapidly in practically all of the operations where the material is exposed as an open sliver. To compensate for this loss, water is applied on the gill box immediately before the sliver is wound into a ball. The sliver, as it passed from the delivery rolls, runs over a brass roll which slowly revolves in a trough of water maintained at a constant level. The speed of the roll controls the amount of water picked up by the mohair, and should be just sufficient to put the sliver in a satisfactory condition. A proportion of 81⅔ per cent mohair, 2⅓ per cent oil, and 16 per cent water has been used to advantage.

#### Top Gill Box

With one or two minor variations this machine is similar to the can gill box. The product is wound into balls instead of being deposited in cans.

The balling of the top is accomplished by means of a balling head. It is very essential that the tops, or balls, be properly built to prevent the edge from fraying, and looping some of the fibers. These conditions will cause slubs, or thick places, in the drawing processes and in the yarn. When a definite length is wound into a ball the machine automatically stops, or knocks off, and the ball is removed.

## DRAWING OPERATIONS

When the slivers of mohair leave the top gill box, in the form of tops, they are ready for the drawing processes. The first step is to continue the operation of parallelization of the fibers and to reduce the slivers to the small rovings put up at the back of the spinning frame. This process of reduction is essentially a gradual one, and is not accomplished entirely on one machine, but is the result of what is called a "set of drawing." The fineness of the yarn to be manufactured governs the number of operations in a set of drawing. These will vary from six to nine.

### Can Gill Boxes (Twice)

When commencing a set of drawing a suitable number of ends, or slivers, are doubled at the feed end of a can gill box. The operation of this gill box is the same as has been previously described. The slivers pass through the feed rolls, are carried forward by the fallers to the delivery rolls, and are finally deposited in a can as a continuous united strand.

A measuring device is attached to the first of these two machines, and the gill box automatically stops when a definite yardage has been delivered. When the cans are taken to the second can gill box they are weighed and combined so that each set of cans feeds in a definite weight of mohair per yard. It is important to have the slivers uniform as early as possible in the drawing processes, for it is evident that a number of slivers of exactly the same size and weight will work together better and give better results than the same number of slivers which vary in size and weight.

### Two-Spindle Gill Box

With the exception that the product, instead of being deposited in cans, is wound onto bobbins, or spools, which are raised and lowered automatically and placed on spindles, there is no difference between these gill boxes and any of the others. There are two spindles to each gill box. A large flyer attached to the top of the spindle places twist in the sliver, and at the same time winds it onto the bobbin.

By twist is meant the entwining of the fibers about themselves. This is accomplished in the drawing operations and in the spinning operations by having the spindle travel at a higher rate of speed than that at which the material is being delivered by the front rollers. The excess speed tends to twist the fibers about themselves; that is, if the front rollers deliver 3 inches of material while the spindle revolves six times, the silver will contain two turns of twist per inch. Twist is necessary from this point on, to insure that the material will unwind smoothly, evenly, and uniformly in the subsequent operations. Just sufficient twist is inserted in the drawing operations, to hold the material together. Too much twist requires more weight and more power than should be used, in the subsequent operations; it has a tendency to result in broken fibers, uneven sliver, consequently uneven yarn, and a high percentage of waste. Naturally as the sliver is reduced in diameter the number of turns of twist per inch is increased.

### Heavy Drawing Box

The drawing boxes differ radically from the gill boxes. They consist of a set of feed rolls and delivery rolls which accomplish the drafting or attenuation. In place of fallers, carriers—that is, small rollers set between the feed rollers and delivery rollers—control the short fibers as the sliver passes through the machine. Spindles are employed to perform the same duty as in the two spindle-gill box (p. 106).

### Weigh Box

The weigh box is a drawing box, but it requires more care and attention than any other machine in the set of drawing. It is here that the final evening is accomplished. The empty bobbins are balanced to weigh the same; therefore full bobbins from the weigh box should be equal in weight. Differences in weight indicate uneven sliver. The full bobbins are made up into sets of equal weights for the following operation; i. e., so that the combined weight of slivers on a definite number of bobbins will be equal behind each spindle.

### Finisher Box, Fine Finisher Box, Reducer, and Rovers

These last four machines and the weigh box are similar to the heavy drawing box with three exceptions: (1) As the sliver decreases in diameter more twist is inserted; (2) as the sliver decreases in diameter the number of doublings decreases until a minimum of two is reached; and (3) as the sliver decreases in diameter the number of spindles per machine increases, and the bobbin dimensions decrease.

## SPINNING OPERATIONS

After the mohair has passed through the set of drawing, it is taken into the spinning room. In this department the roving is given the final attenuation and twist, unless it is to be plied, and the product is the finished yarn.

### Flyer Spinning

The objects aimed at in spinning is the continual drafting of the roving in order to effect the attenuation to the desired yarn counts, to twist the drafted sliver to impart strength and handle to it, and to wind the yarn in a convenient form for manipulation in the succeeding processes. Prime requisites of the yarn are that it shall be of the desired uniform counts, of the desired strength, of the desired smooth, even appearance, and of the desired handle.

The spinning of mohair is accomplished on the flyer spinning frame. (Fig. 43.) The frame is similar in the principle of drafting, twisting, and winding to the roving frame used in the set of drawing. The construction is of a finer type, the number of spindles are greater, and the spindles are arranged on both sides of the machine.

The amount of twist inserted in the yarn is considerably greater. It varies with the yarn counts and depends upon whether the yarn is to be used as warp or filling in weaving. The filling yarns are twisted just sufficiently to insure a soft, smooth, lustrous yarn, with sufficient

strength to withstand the shock and friction of passing through the shuttle in weaving. The warp yarns are given considerably more twist. This is essential because of the great strain placed upon them by the operation of the loom and the friction of the shuttle in passing back and forth between them.

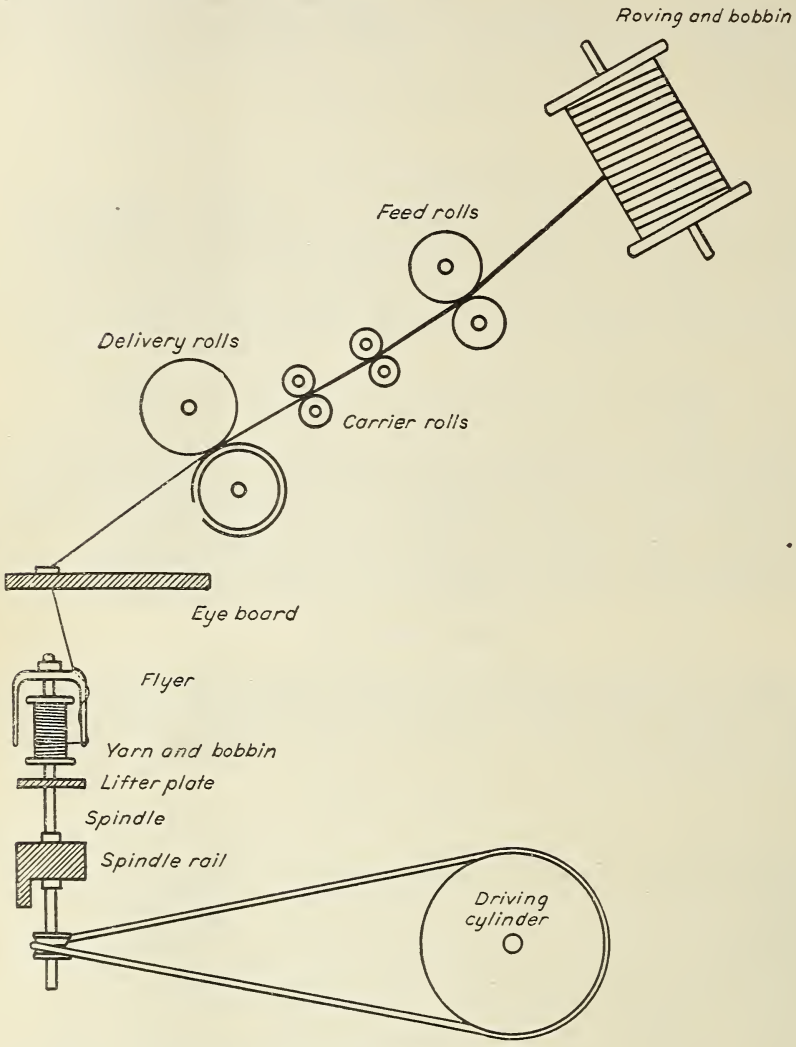


FIG. 43.—Spinning frame

## TWISTING

Twisting is the term usually applied to the operation of combining two or more yarns to form a ply or folded yarn. Mohair yarns intended for the warp in weaving are generally plied; the filling yarns may or may not be, depending upon the type and use of the fabric to be made.

In spinning the sliver is drawn, twisted, and wound on to bobbins; in twisting, the yarns are simply twisted together and wound on to bobbins. The essential parts of the twister are a single pair of rollers and a spindle. As in spinning the spindle travels at a higher rate of speed than the material which is being delivered.

## WEAVING OPERATIONS

Yarn leaves the spinning frame or the twisting frame on bobbins which are frequently inconvenient to handle, so far as the subsequent operations are concerned, and accordingly it is necessary to rewind it on another form of package before weaving it on the loom. The filling yarns are wound upon bobbins that will fit the shuttle of the loom. The warp yarns are wound upon a large double-headed spool known as a beam. Each warp thread is laid parallel to the next; sufficient threads, depending upon the number of threads per inch and the width of the fabric, are wound.

### Warp Dressing

Warp dressing consists of preparing the warp for the loom. In addition to winding of the individual yarns onto a large beam according to specifications as to length, width, number of threads per inch, when various colored threads are to be used, the threads are also distributed according to a prearranged pattern furnished by the designer. It is absolutely necessary that extreme precaution be taken, for, if a mistake is made in the pattern, if the warp be wound unevenly or not firmly, it is almost impossible to remedy defects. The results of these defects are a cloth woven unevenly, streaky dye effects, and a rough-looking fabric.

### Spooling

The first operation in beaming, or warp dressing, is spooling. This operation consists of winding the yarns upon jack spools; wide, double-headed spools capable of holding 40 to 50 threads lying side by side. Care must be taken that the tension upon the yarn on all spools is equal, that the yarns on all spools are of equal length and that there are no loose threads or ends. These defects can spoil the warp.

The jack spooler is very simple. The bobbins from the previous operation are placed on the pegs of a rack, or creel. Each end is passed through two sets of stationary guides. It then passes through a guide with an oscillating motion, around two rollers for tension, through a second oscillating guide, and is finally wound onto the jack spool. The spool rests upon a drum, positively driven, which is 1 yard in circumference. The object of both of the oscillating guides is to distribute the yarns evenly on the spool and to prevent the yarns from rolling over and entangling the adjoining end. A measuring device, connected to the drum, registers upon a dial every 30 yards delivered.

If an end breaks, the operator immediately stops the machine and repairs the break.

### Sectional Dressing

In sectional dressing the warp is unwound from the jack spools, wound in sections, and finally combined on the loom beam.

A rack, usually capable of handling 12 jack spools, is provided. Each spool is provided with an adjustable device designed to impart a constant tension to the yarn. The yarns are passed through a pattern reed (a comblike device through which the yarns are threaded in accordance with the desired color schemes if colored yarns are to be used) and then around two rollers. The second roller operates a measuring device so that the yardage may be known. After the rolls the yarns are passed over a device, called a rocker, which rapidly moves them up and down. This device not only assists the yarns to pass through the lease reed which follows, but helps to dry, cool, and separate the yarns if they have been sized or treated with a material to aid in the weaving process. The lease reed forms a one-and-one lease by simply raising and lowering alternate ends.

After leasing the yarns are passed through a condenser, or neck reed held in an iron frame, which reduces the breadth of the material to the desired width. The reed is a steel comb blocked at both ends and containing a definite number of spaces per inch. Each space is called a dent. The narrowing is accomplished by threading one or more ends per dent. The yarn is now run on to a creel which is provided with pins to hold the yarns rigid and to the desired width. When all of the yarn has been placed on the creel it is finally run off on to the loom beam, the heads of which have been set to the width that the yarn occupies on the creel. During this operation, known as beaming, the yarn is not allowed to pile up on one side; the selvage threads are not allowed to cut on the beam heads; and an even tension is maintained.

If the warp is to be sized the dresser is provided with a tank to hold the sizing fluid, a pair of squeeze rollers, drying drums, several steam coils, and a fan. After the yarn has been sized and dried it is wound upon the creel and then on the loom beam as previously described.

Mohair yarns are not generally sized. If there are to be a large number of ends and picks per inch in the fabric sizing is necessary, owing to the long fibers, loosened by the action of the reed in weaving, adhering to each other or adjoining ends. The fibers collect behind the reed and form lumps, or balls, and cause an excessive amount of breakage. The object of sizing warp yarns is to furnish each end with sufficient strength and resistance to withstand the chafing and strain encountered in weaving.

Another type of section beamer consists of a drum which rotates a section beam upon which the ends are wound. The bobbins of yarn are placed on a V-shaped rack according to the pattern desired, if any. The number of section beams wound depends upon the number of bobbins the rack will accomodate, and the number of ends desired in the warp. The beams are then combined on a warp beam by passing the ends over a slasher.

The slasher consists of a rack for holding the section beams, a tank for holding a size mixture, several squeeze rollers to eliminate an excess of size, a large steam-heated copper cylinder for drying the yarns, if sized, and a winding device to hold the warp beam and rotate it.

### Weaving

Weaving is the mechanical process of interlacing two systems of threads, at right angles to each other, to form a fabric. The operation is accomplished on the loom. (Fig. 44.)

### Drawing In

After the warp has been beamed, it is sent to the drawing-in department, where the individual yarns are carefully drawn through the drop wires, heddles of the harnesses, and the loom reed. This is done according to a prearranged design. Single ends usually are

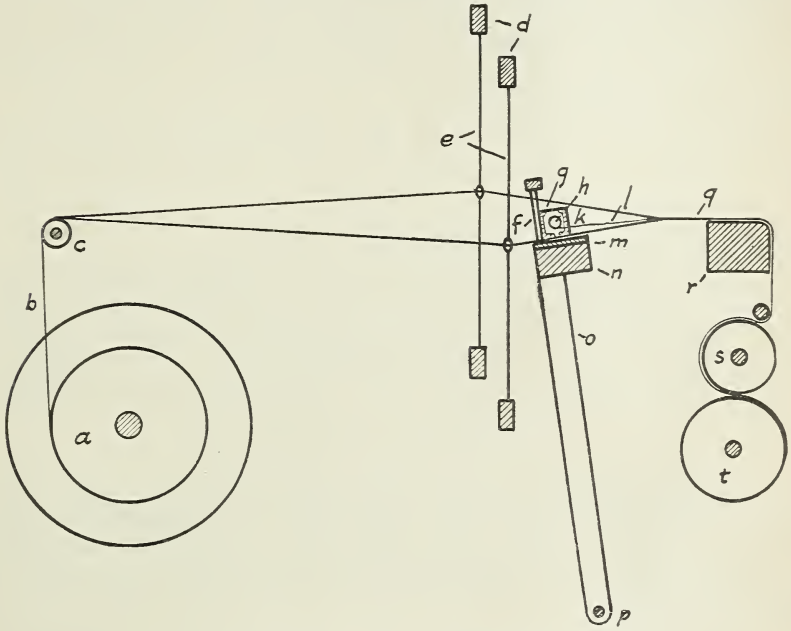


Fig. 44.—Typical power loom

drawn through the drop wires and heddles, with the exception of those intended for the selvage. The reed is generally drawn two ends per dent.

### Weaving

The warp is now placed in the loom (fig. 44), the drop wires set in position, the harnesses hung in place, and the reed clamped in the lay. The loose ends are tied to a piece of fabric, and the necessary adjustments of the loom are made. A bobbin of filling yarn is placed in the shuttle, a hollowed-out, double-ended, steel-tipped block of wood. The loom is now ready to operate.

As the loom operates, the lay, which is a movable section carrying the reed, shuttle, shuttle boxes, race plate, and picker sticks, swings backwards. At the same time one or more harnesses rise, forming

the warp into two systems of threads called the shed. At the position of the greatest shed the picker stick is actuated and drives the shuttle across the race place and between the warp threads. In this motion of the shuttle, due to the tension, yarn is unwound from the bobbin and deposited in the shed. After the shuttle has made its passage, the lay swings forward and beats the deposited filling, or pick, up to the fell of the cloth, that is, the junction where the warp threads end and the fabric begins. Concurrently the harnesses that are raised lower to the neutral position, and those that were down are raised, forming a new shed through which the shuttle is again propelled. Thus the interlacing is accomplished.

The number of threads deposited per inch is controlled by a gear which operates after each pick is beaten up by the lay, and carries the warp and fabric forward. The fabric is wound under tension upon a roll called the cloth roll. During weaving the warp is always kept under a constant tension.

The harnesses are wooden frames which hold the heddles, steel wires with an eye in the center, through which the warp is laced. Every heddle on a single harness is raised and lowered at the same time and thus gives the group of threads they control a definite position in the fabric. The number of harnesses used depends on the design of the fabric and ranges from 2 to 24.

Pile fabrics may be woven with an extra warp called the pile warp. The pile is constructed by raising the pile threads and inserting a wire. The pile thread is then lowered and interlaced with the regular or ground warp. The loops formed by the yarn passing over the wire are cut upon withdrawal of the wire and form the tufts of pile.

## FINISHING OPERATIONS

The mohair fabric, as it comes from the loom, may be dirty, lusterless, and more or less open in construction. Weaving defects, such as broken threads, knots, miss picks, etc., stand out conspicuously. To remedy these defects and to give the fabric a smooth-appearing lustrous surface, it is submitted to a series of treatments called the finishing processes.

These operations are divided into two departments; namely, the wet finishing and the dry finishing. The preliminary operations of inspection, burling, and mending are not regarded as part of the finishing and are usually handled in a separate department.

The amount of finishing accorded a fabric depends upon the type, quality, and use of the fabric.

### Inspecting

The goods are generally inspected in the weave room before they are sent to the finishing department. However, this is merely a superficial examination, with the purpose of determining the efficiency and carefulness of the weaver, and no attempt is made to correct defects. In the finishing department the fabrics are inspected very carefully to find all imperfections, no matter what the size or cause, and to mark them properly with chalk. All defects are remedied, so as to produce a piece of cloth as nearly perfect as possible.

Lightweight fabrics, through which light will readily pass, are inspected at the perch. The perch consists of two wooden rollers or bars, a distance apart, hung from the ceiling and facing toward a window or light. The cloth is thrown over the rollers. The inspector stands between the two folds of cloth and looks through the fabric toward the light. The slightest variation or defect in the fabric is instantly noticed, and chalk marked on the face of the fabric. Defects that can not be remedied are given a distinctive mark. The chief defects are missing warp threads, and missing picks. Thick and thin places, caused by a variation of the number of threads or picks per inch or by a variation in yarn counts, are also marked. These last variations are somewhat, but not entirely, overcome in the finishing due to the shrinking of the fabric in the warp direction. After the material has been dyed they show up as rows of coloring.

At the same time as the fabric is inspected it is also measured, and the weight per cut in pounds, or the weight per yard or piece, is determined in ounces.

### Burling

The object of burling is to raise and straighten all knots tied in the process of weaving and to remove all bunches and loose ends, in fact remedy everything that will interfere with the smoothness of surface of the fabric. In burling, the goods are drawn over a table the top of which is elevated to an angle of 45°. The top is well joined and smooth so that the burler may readily feel every knot and bunch.

The back of the fabric is burled first. A length of the cloth is pulled over the table, and the burler rubs his hands over the surface of the goods. The knots located are carefully drawn to the surface; the loose ends and bunches are cut off close to the surface. Care is taken not to draw them too tightly nor to cut them too close as they will crawl back and cause an imperfection.

After the back has been burled the material is turned over, and the face is burled. The knots found on the face are forced through the proper interstice and onto the back of the fabric. Later the knots are removed or cut very closely in the process of shearing.

### Mending

In mending the material is again drawn over a perch. The mender repairs all defects marked by the inspector as capable of being fixed. The process is simply to sew in yarns to replace those missing. The weave, pattern, and color scheme of the fabric is followed exactly.

### Crabbing

The process of crabbing is the first operation in wet finishing. The object of crabbing is to set or fix the fabric in a certain position as regards to length and width; to impart to the fabric a certain amount of stability, and to set the weave in such a manner that it is not distorted in the succeeding processes.

The principles of crabbing are (1) to apply moist heat to the fabrics to make the yarns plastic; (2) to apply tension in the warp

direction so that all warp threads will become parallel and so that the filling will interlace about the warp; (3) to apply pressure to press the yarns in the desired position; (4) to cool the fabric and set the yarns in the desired positions. Thus the fabric stretches in length and shrinks in width. Furthermore the filling is thrown to the face of the fabric.

The cloth is passed over a series of wooden tension bars, to straighten and apply tension to the fabric and to assist in winding the fabric evenly upon a wooden roller called a loading drum. A tank, or bowl, is filled with water, which is brought to a boil by means of live steam. The steam is shut off when the water boils. The fabric passes under a small immersing roll in the bottom of the bowl, and is wound upon the lower of a pair of solid metal rollers. Of this pair the lower is partly immersed in the boiling water; the other acts as a nip and to apply pressure. The fabric rotates on the roller for a definite period of time and is then wound upon a wooden roller. The roller is removed from the crab and stood on end for a definite period, during which it is reversed end for end. In order to equalize the tension on both ends of the fabric, it is again run into the bowl of boiling water. After the fabric has been rotated a suitable length of time, instead of being wound immediately on the wooden roller, it is rotated in a bowl of cold water. It is now wound on the wooden shell and stood on end as previously described.

### Scouring and Washing

During the yarn manufacture and weaving operations foreign impurities collect, and are deposited on the fabric. These consist of the oil necessary to facilitate the preparing and spinning of the yarns and the dirt that adheres to the fibers because of the presence of the oil; machine-oil stains; sizing compound if the material has been sized; and an excess of dyestuff not absorbed during the dyeing process. With these present the fabric presents a dirty, spotty, lusterless appearance. To eliminate these impurities the fabric is scoured and washed. This is accomplished in the string washer. Previous to scouring and washing the machine-oil spots are treated with materials that emulsify the oil.

The main features of the washer are a deep pit, the bottom of which is curved and smooth, usually with a perforated false bottom of wood; several guides; a pair of squeeze rolls; a suds box with a perforated bottom; and a creel.

The fabric is folded down the middle and the selvage tacked (sewn together with a lock stitch). One end of the fabric is lowered into the pit, which holds the soap solution and the fabric, and is then brought up on the other side of the washer where it is passed between a pair of wooden pegs called a Jacob's ladder. It is then passed around a wooden guide roll, through a wooden guide ring lined with a porcelain pot eye, then between a pair of heavy wooden rollers, to the top one of which pressure can be applied. After passing between the rollers the end of the fabric is passed over the creel. The two ends are now sewn together to form a continuous string.

The pit is now one-half filled with warm water of a temperature of 110° F. The fabric is run in this for a short period to soften and loosen the oil, which has been hardened in the crabbing process. Sufficient soap is then added to form good suds.

As the fabric leaves the creel it drops down into the pit and folds upon itself. The fabric is gradually drawn through the liquor by means of the squeeze rolls pulling upon it. At the squeeze rolls the soap is thoroughly squeezed out, carrying the dirt, emulsified oil, and other impurities with it. The soap drops into the suds box and at first is allowed to drop back into the pit. Later, as the soap becomes saturated with dirt, the perforations in the box are closed, and the suds are passed to the sewer.

After a period of time a valve in the bottom of the pit is opened, and the dirty liquor is allowed to run off. A finely divided spray of clear warm water is next directed against the fabric until the soap is washed out; a rinse in cold water then follows.

### Steaming

The action of scouring and washing tends to offset the effect of crabbing. To remedy this all lightweight fabrics are crabbed again. However, instead of winding the material on a wooden roll after it is crabbed it is wound on a perforated iron shell so connected on the crab that live steam can be blown through it and the fabric. After the steaming the material is allowed to remain on the steam shell overnight. Steaming sets the fabric better and produces a higher luster than crabbing alone.

### Drying

The piece now requires singeing, but, being in a damp state, it must first be dried. To effect this it is passed around heated drums driven so as to carry the fabric forward under the proper tension.

### Singeing

Most mohair fabrics, except upholsteries, or those of a similar type with a pile surface, are given a thread finish; that is, every thread stands out clearly and prominently. This increases the luster, or sheen, of the cloth. Singeing helps to accentuate this condition by burning from the surfaces and interstices of the fabric the loose fibrous nap which is brought up in the spinning and weaving operations.

The singeing of mohair fabrics is accomplished by passing the fabric, full width, over a series of curved copper plates which are highly heated. Rollers for traversing the fabric at a regular and controllable speed are supplied. There is also an arrangement for lifting the fabric off the plate, should such a necessity arise. Care is taken to maintain the entire width of the plates at a uniform heat.

### Dyeing

If the material is to be of solid shade it is taken, at this point, to the dyehouse, and after dyeing is returned to the finishing depart-

ment. The dyeing is accomplished by running the fabrics through a solution of the dyestuff a sufficient number of times to get the desired shade. Only one-half of the dyestuff is entered into the bath at the start. After the fabric has been through once the other half is put in.

### Washing

After the fabric is dyed it is again washed with soap and warm water in the string washer. This washing eliminates any excess dyestuff left in the fabric.

### Extracting and tentering

After it has been washed the fabric must be brought out to its required width and leveled. It is hydro-extracted and then placed directly upon a single-length tentering machine.

The machine is one long length. The fabric is hooked on to a pinned chain which carries it forward over steam sprays. The steam softens the fabric previous to widening. As the chains holding the fabric pass down the machine they gradually diverge until the fabric is stretched to its desired width. The drying device consists of either a series of gas jets or steam coils.

### Shearing

Shearing is generally used in the manufacture of mohair fabrics upon the pile fabrics only. After this type of fabric has been cut through, as explained under weaving, the tufts of fibers are uneven and ragged. In order to obtain a uniform surface with each tuft the same height, the top of the tufts are cropped on the shear.

The shearing machine is fitted with knives similar to those of a lawn mower, an adjustable bed plate, and a set of tension rollers to keep the fabric always under an equal tension. Stripe patterns can be produced upon the pile woven fabrics by use of an indented bed plate.

### Finished Mending

Some defects are usually caused in the finishing processes, or are overlooked in the first inspection and mending. To remedy these the fabrics are inspected and mended at this point.

### Decating

Decating or decatizing refers to the dry-steaming operation in which the dry fabric is treated with steam under pressure. If used before pressing the object is to give the fabric additional setting; if used after pressing the object is to impart an additional luster.

### Dewing and Pressing

Before it is pressed the fabric must be uniformly moistened, either with steam or a fine mist of water, so that during the pressing the cloth will flatten, producing luster, increased density, increased firmness, and increased thinness. There are a number of different types

of dewing machines on the market. The principle of all is to subject the fabric to a finely divided spray of water and then to wind it upon a shell.

Pressing is the last of the finishing operations and also the last of the processes of manufacturing mohair fabrics. In pressing the fabric upon a rotary press it is subjected to a heavy pressure between an iron cylinder and two press beds (plates) cut concentric with the cylinder. Both the plates and the cylinder are heated with live steam. The water sprayed on the cloths in dewing comes in contact with the hot cylinder of the press and is converted into steam. This steam permeates the fabrics and aids the pressure in flattening the cloth as it makes the fibers plastic. The fabric is cooled in this state and either dewed or decatized to condition it.

### Measuring, Rolling, and Packing

The fabrics are now measured for length, wound into rolls or folded upon flat strips of wood, and packed for shipment.

As stated previously, the material may pass through all or only a part of these operations, depending upon its character and desired use.

## SUMMARY

Specialized production of Angora goats and mohair has been developed primarily in Turkey, the Union of South Africa, and the United States. Many attempts have been made to establish Angora goats in Europe, but none of these attempts were successful. From the dawn of history until after the middle of the nineteenth century the region known as Angora in Turkey was the only important Angora-goat country. The Union of South Africa secured its first small importation of Angora goats from Turkey in 1838, and the initial importation of this breed of goats into the United States came from Turkey in 1849.

The Turks were reluctant to export these mohair-bearing animals, and development in other countries was comparatively slow until about the close of the nineteenth century. By 1900 breeders in the United States and South Africa were making important progress. At that time the registration of purebred Angoras was established in both these countries, and since that time these two countries have enjoyed a steady and substantial improvement in this breed. There have been no importations of Angoras from Turkey into the United States since 1901. In 1904 there was a large importation into the United States from South Africa. Importations of Angora goats into this country then ceased for a period of 21 years, the next and last foreign goats being received from South Africa in 1925.

Angoras have been raised in all regions of the United States. In 1920, every one of the 48 States reported fleece-bearing goats, but approximately 90 per cent of them were in the Southwest and the Pacific coast region in Texas, New Mexico, Arizona, California, and Oregon. Missouri had about 3 per cent of America's fleece goats, and in all other States they were of minor importance. The greatest concentration is on the Edwards Plateau of southwestern Texas, where about 70 per cent of them were found in 1920.

The expansion of the industry in the United States has been accompanied by improvement of the goats and their fleeces. The average annual fleece weights were about 19 per cent heavier in 1927 than in 1920. Breeders are also giving attention to the improvement of quality in the mohair, including the elimination of kemp.

The pioneer phase of the industry is passing. A large percentage of the goats are grazed on owned or leased lands. The investment in goats and equipment is so great that wasteful methods will lead to failure. Goats must be handled with care and in accordance with the results of scientific investigation if the venture of mohair production is to prove profitable. In the six important mohair-producing States the number of fleece goats increased nearly 35 per cent and the production of mohair 59 per cent from 1920 to 1927.

There is a healthy demand for mohair fabrics, and manufacturers are eager for mohair of high quality, but improvement in the quality of the goats and their fleeces, increased efficiency in production and marketing methods, and the establishment of official United States standards for grades of mohair are of primary importance to growers and to the industry as a whole. Recent expansion has been so rapid that caution should be exercised in the matter of increasing the numbers of Angora goats except as would be justified by increased demand for mohair.

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